Chapter 6

SATELLITE COMMUNICATIONS

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INTRODUCTION

Space Policy and International Telecommunications Policy

Satellite communications is the only substantial commercial exploitation of space. As communication satellites came into commercial use, many people concerned with international satellite communications policy assumed that most of the important issues in the satellite arena could be analyzed apart from the regulatory issues of the wider telecommunications industry. The policy they made, embodied initially in the Communications Satellite Act of 1962 and the INTELSAT Agreement of 1973, evolved with its own momentum, its own objectives, and its own "space" constituencies. The Federal Communications Commission (FCC) then molded the regulatory framework to accommodate the policy framework.

Recently, the regulatory framework that the FCC put in place to reconcile U.S. international satellite communications policy with commercial reality has come u rider new challenge in a number of different contexts and must adapt in fundamental ways. Technological, economical, and regulatory changes have resulted in a situation where almost no aspect of international satellite communications can any longer be analyzed apart from the international telecommunications industry—terrestrial and satellite—as a whole. At the same time, most of the major issues in international satellite communications have also become issues of telecommunications regulation rather than space policy.

International competition in satellite communications equipment has also taken on a new dimension now that the U.S. market has opened up because of domestic deregulation. Foreign suppliers, who had hitherto largely sold in protected markets or according to the allocation formulas of international agencies, are free to sell in the United States, but U.S. suppliers are seriously restricted in Europe and Japan.

The International Satellite Communications Industry

These shifts in policy emphasis are taking place at a time when satellites provide the dominant transmission technology in international telecommunications. Approximately two-thirds of transoceanic international telecommunications now pass through satellites; the remainder is carried via undersea cables.[1] The information transmitted includes not only telephone conversations, telex messages, and television programs, but increasing amounts of computer-processed data. In the future, videoconferencing may become a large service. Multinational corporations now send large quantities of data around the world within private line networks. In the general international economy, the exchange of goods and services among nations is paralleled by streams of related information and electronic financial transfers.

More and more, the same firms that carry data from one point to another also process the data. This merger of two formerly separate activities–telecommunications and data processing—already has led to substantial regulatory changes in both the domestic and international telecommunications of the United States, a process that is beginning to occur in several other countries as well. The 1984 breakup of AT&T in an antitrust consent decree is the most spectacular, but only one, result of the pressure that technical changes are placing on regulatory structures.[2]

Within the United States, several of the largest U.S. corporations now offer both domestic and international satellite communications services. AT&T, Western Union, IBM, RCA, ITT, and GTE

[1] Departments of State and Commerce, "A White Paper on New International Satellite Systems," February 1985, p. 7.

[2] U.S. Congress, Office of Technology Assessment, *Effects of Information Technology on Financial Services Systems*, OTA-CIT-202 (Washington, DC: U.S. Government Printing Office, September 1984), ch. 6.

are important examples.* Each of the three largest communications satellite makers—Hughes, Ford, and RCA—also offers, or is about to offer, satellite communications services. In addition to these firms, which offer services for sale, a number of large U.S. firms, e.g., Citicorp and General Electric, have sizable private communications networks.

Abroad, the picture is much different: except in a few countries, telecommunications is a government monopoly (the so-called "PTT" or post, telegraph, and telephone **entity).**[3] **Internationally, the International Telecommunications Satellite** *Organization* (INTELSAT), a consortium with more than 100 member countries, is the monopoly provider of intercontinental satellite facilities.[4] INTELSAT was established under **U.S.** leadership pursuant to the Communications Satellite Act of 1962, which also authorized the charter of the Communications Satellite Corp. (COMSAT) as a private company. COMSAT is a carriers' carrier (all U.S. carriers sending international satellite communications via the INTELSAT system must pay COMSAT's tariff) and represents the United States in the INTELSAT Board of Governors. It currently has an investment share in **INTELSAT of 23 percent. Other countries are typically represented on the INTELSAT Board of Governors by their PTTs.**

Both INTELSAT and the PTTs in the industrial countries are beginning to feel pressures for increased openness to competition—pressures from the **continued growth of demand for telecommunications services, from the new information and telecommunications technologies, and from the new competitors** in the U.S. markets **They fear that unilateral moves by the United States** will cause changes in the current international regulatory regime that will make them change valued modes of operation and, in the case of INTELSAT, threaten its economic viability.[6] At the same time, some developing countries are demanding changes in the ways in which the international community assigns the radio frequencies and geosynchronous orbital positions.

International Cooperation in Satellite Communications

The United States cooperates extensively in international satellite communications and, in addition to its membership in **INTELSAT, participates** in several other international organizations concerned with it. U.S. concerns in these cooperative processes are not only related to the welfare of U.S. producers and consumers of telecommunications services and equipment. They also are concerned with linkages to wider foreign policy concerns—e.g., relations with other industrial countries and with the developing world, global national security communications capabilities, the effectiveness of international institutions, and the general international trading system.

***Several of these firms use their own satellite systems for domestic satellite services; the others lease transponders from satellite providers. For reasons discussed below, virtually all International satellite communications are sent via leased transponders.**

[3]The divestiture decisions contained in the AT&T consent decree are, of course, just one of the possible ways in which industry structures could be reformed to take account of the new technological realities. Other countries, notably the United Kingdom, Japan, and France, responding to these same technological realities by altering industry structures in other ways.

Some traffic is now or will shortly be carried on regional systems in the Western Hemisphere, Southeast Asia, Europe, and the Middle East, on INTERSPUTNIK, a Communist bloc satellite system, and on INMARSAT, an international system for marine communications. The Western Hemisphere regional system is often omitted from the list of regional systems, perhaps because it is made up of unrelated private carriers rather than operated by an intergovernmental organization, and is usually referred to as "transborder services." Currently, U.S. domestic satellite operators are authorized to carry international traffic to Canada, Mexico, Bermuda, and many locations in the Caribbean.

[5]Eli M. Noam, "Telecommunications Policy on the Two Sides Of the Atlantic: Divergence and Outlook," Columbia University, Research Program in Telecommunications and Information Policy, New York, Aug. 15, 1984. See also testimony and statements in "international Satellite Issues," U.S. Congress, House Committee on Energy and Commerce, Subcommittee on Telecommunications, Consumer Protection, and Finance, Hearings, June 13, July 25 and 26, 1984, Washington, DC, 1985,

[6]We use the term "international regulatory regime" (Or "international communications regime") broadly to include all governmental and intergovernmental actions affecting the operations of the international communications carriers. These include treaties and other formal and informal intergovernmental agreements in the area of telecommunications, other elements of international law affecting telecommunications, the actions of international organizations such as the ITU or INTELSAT, and the actions of national governments that affect the international telecommunications industry.

Policy Issues

These pressures for change pose issues for U.S. **international communications policy that involve both international competition and international cooperation. Important current policy issues of relevance to international satellite communications are mentioned below.**

Competition for INTELSAT

Should the United States attempt to foster greater competition in the provision of international satellite communications facilities? If so, would the United States serve this objective, and wider U.S. foreign policy concerns, by allowing private U.S. firms to construct satellite facilities for use in whichever country markets they can gain entry, in possible competition with INTELSAT?

Competition for COMSAT

Should other U.S. telecommunications carriers be allowed access to INTELSAT on the same basis as COMSAT? If COMSAT continues as the sole U.S. investor in INTELSAT and as the sole U.S. "wholesaler" of international satellite communications, should COMSAT be required to divest itself of its other activities or could they be carried out in separate subsidiaries, as at present, with accounting controls to guard against its monopoly activities cross-subsidizing its competitive ones?

Satellites v. Cables: Facilities Regulation

How will the international facilities regulation of the FCC affect the future of satellite communications? The future distribution of traffic in international communications between satellites and undersea cables is partly dependent on the cost and performance characteristics of the two technologies, but it also depends on whether the Government regulates investment in new satellite and cable facilities and whether it mandates the shares of the traffic that U.S. service carriers must send over the two media. Should the current regulatory regime be maintained or can competition be relied on to determine investment in long-distance international facilities in the same manner that it does in the substantially deregulated U.S. domestic telecommunications industry?

Access of U.S. Carriers to Foreign Telecommunications Service Markets

Now that several dozen large U.S. corporations are active in U.S. domestic satellite communications, as basic, enhanced, or private communications providers, how can the United States endeavor to assist them in gaining access to foreign telecommunications service markets (principally in the industrial countries)? Should the United States adopt a demanding posture at the risk of straining relationships with our principal trading partners?

International Trade in Satellite Communications Equipment

What additional action should the Government take to try to assure fair international competition in both space- and ground-segment equipment? Can foreign governments be persuaded to end their PTTs' discriminatory procurement policies by agreeing to apply the GATT agreement on government procurement (or a similar principle) to PIT procurement of telecommunications equipment? Would reciprocity legislation help? How disadvantaged are U.S. satellite communications equipment makers likely to be in the availability of and interest rates charged for official export finance for sales to less developed countries? Would a new international agreement help?

NASA Satellite R&D

How much should the Government spend on research and development to help keep the U.S. satellite manufacturing industry technologically vital and ahead of potential foreign competitors? In particular, is the NASA Advanced Communications Technologies Satellite (ACTS) program a desirable program that the private sector is not financially capable of mounting? Or should the private sector be relied on to do its own R&D? Should the U.S. Government match foreign civilian R&D programs in satellite communications or would the ACTS program actually engender greater foreign efforts to surmount U.S. dominance in communications satellites? Finally, how much success is a government-conducted R&D program likely to have in developing marketable technology?

Space WARC

What should be the U.S. approach to cooperation with other countries in international telecommunications organizations? In particular, how should the United States approach the international Telecommunication Union's (ITU)upcoming World Administrative Radio Conferences on space services ("Space WARC"), so as to protect U.S. access to the geosynchronous orbit and the radio frequency spectrum? Should temporary or permanent withdrawal from ITU' (and other international organizations concerned with satellite communications, such as the U.N. Committee on the Peaceful Uses of Outer Space (COPUOS) be considered as active contingencies in the wake of U.S. withdrawal from the U.N. Educational, Scientific, and Cultural Organization (UNESCO)?

Aid to Developing Countries

Should Congress attempt to direct more U.S. development-assistance resources into telecommunications? Should the United States encourage multilateral assistance to developing countries through the World Bank or specialized international telecommunications institutions, such as INTELSAT (cross subsidies) and the ITU (development assistance), or are bilateral programs, such as those that might be carried out by the U.S. Agency for International Development (AID), more effective in achieving U.S. objectives? Can mixed credit programs f~r buyers in developing countries assist U.S. telecommunications exports?

The Demand for International Satellite Communications

The Importance of the Demand Factor

The demand for satellite communications, its size and rate of growth in this decade and in the **1990s, will be one of the fundamental variables affecting issues of importance to the United States in international space and telecommunications** policy.[8] The prospect of high demand for satellite communications over the North Atlantic would make it easier for the United States and other governments to allow the entry of private satellite communications firms in competition with INTELSAT. High demand for satellite communications services would also result in higher derived demand for space transportation services and for satellite equipment and would affect international competition in both areas. One effect of high demand would not be favorable, however. High demand would tend to exacerbate any situation of crowding in the geostationary orbit.[9]

Growth of International Telecommunications as a Whole

U.S. international communications has been growing rapidly since high-quality voice service was inaugurated in transatlantic service via undersea cable in 1956. U.S. carriers' international real revenues grew at an annual average rate of approximately 13 percent during the 1972-84 period (table 6-l). For 1985, the Department of Commerce projects a growth rate of 14 **percent.**

[7]Whether significant cross subsidies are created by INTELSAT pricing is in dispute (see below).

[8]Care should be taken with the concept of "demand for international satellite communications, " since satellite communications and terrestrial communications are extremely close substitutes in telephony and most other international volume applications. It should probably be thought of as a demand derived from total international telecommunications demand that is determined by the institutional and regulatory structures of both cables and satellites and also by the relatively small differences in the characteristics of the services provided. The general conclusion that satellite and cable transmission modes are close substitutes is not changed by the existence of certain uses, such as point-to-point television or certain high-speed interactive data communications, where the two modes are not close substitutes. At present these uses are relatively low-volume uses in international satellite communications.

[9]Crowding (or congestion) in the geostationary orbit is said to occur when preferred or substitutable orbital slots in a desired frequency band are not available to an applicant. This may be because they are occupied by another satellite or reserved for future use by another user. Thus, the applicant experiences the economic costs of changing desired services. Crowding can be local or can occur in an entire region of the geostationary orbit, such as the Western Hemisphere. Certain observers eschew the term as misleading, since no physical crowding occurs, and the spacing is fixed by regulatory decision. At 2 deg. orbital spacing, for instance, satellites would be approximately 500 miles apart. The volume of two-way communications that can be handled in a given slot also depends on the technology in use by the satellite.

Table 6.1 .—U.S. International Telephone and Telegraph Service Revenues, 1972-85

Year	International revenues (1972$ millions)	Growth rate[a] (percent)
1972	663	—
1977	1,339	15.1 (1972-77)
1978	1,607	5.7
1979	1,906	18.6
1980	2,082	9.2
1981	2,250	8.1
1982	2,325	3.3
1983	2,500	7.5
1984e	2,800	12.0
Average twelve-year period		12.8 (1972-84)
1985p	3,200	14.3

KEY: e = estimated; p = projected.
aAverage compound growth rate calculated on the end points for indicated periods of over 1 year,

SOURCE: U.S. Department of Commerce, *u.S. Industrial Outlook 1985, pp. 31-7, 31-9.*

U.S. carriers expect rapid growth of international communications to continue. In forecasts prepared for a working group meeting in connection with the FCC's facilities planning process, the U.S. international service carriers[10] projected the demand for U.S.-Europe common carrier commu nications (including new services) to increase at an average annual rate of 16.3 percent during the period **1985-95.** They foresee demand for capacity of 82,000 voice-equivalent circuits in 1995.[11]

Table 6-2 shows the distribution of two-way telephone and telex services between the United States and various world regions in 1982. In that year, 86 percent of telephone and 80 percent of telex minutes were transmitted along high-volume corridors to Europe, North Asia, and the Americas.[12] Transatlantic traffic to Europe alone accounted for about 50 percent of total minutes.

Demand Forecasts Subject to Substantial Uncertainty

Forecasts of demand a decade ahead are, of course, subject to wide forecast error, because the assumptions regarding price, economic growth, technology, market development, and consumer response on which they are implicitly or explicitly based are themselves subject to great uncertainty.

One assumption behind the U.S. carriers' forecast stands out as particularly uncertain-their

[10] In 1983, the major U.S. companies involved in the planning process were AT&T, RCA, Western Union, GTE, MCI, and ITT and COMSAT.

[11] This growth rate refers to the forecast of November 1984. Table 6A-1 in app. 6A presents these November 1984 overall forecasts. It also presents 1983 forecasts (which were significantly higher) by carrier and by major destination country.

[12] Not including Canada and Mexico. These percentages are taken from table 6-2.

Table 6-2. -U.S. International Common Carrier Telecommunications Traffic by World Region (Voice and Telex), 1982[a]

	Voice		Telex	
	(million minutes)	(percent)	(million minutes)	(percent)
Europe	1,003	49.7	152	45.2
North Asia[b]	209	10.3	59	17.6
Americas[c]	525	26.0	58	17.2
Subtotal	1,737	86.0	269	80.0
Near East	148	7.4	19	5.7
Other Asia/Pacific[d]	87	4.3	33	9.9
Africa	46	2.3	14	4.3
Total	2,019	100.0	336	100.0

aIncludes only telephone and telex traffic. In addition to telex, which was reported by region and by minutes and which accounted for 70 percent of their revenues, the (former) international record carriers derived 30 percent of their revenues from telegraph messages and private lines.
bJapan, Republic of Korea, China, Hong Kong, Taiwan, Philippines.
cExcluding Canada, Mexico, and U.S. territories. Canada and Mexico are not included in the source FCC data on international telephone carriers. Mexico is included in the data on telex, but for consistency, we have excluded it from this analysis.
dExcluding Hawaii and Guam.

SOURCE: Derived from Federal Communications Commission, Statistles *of Common carders,* year ended Dec. 31, 1982, published in 1984.

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assumption that new services, especially videoconferencing, will not grow to be a large fraction of total demand.[13] A study prepared for NASA in 1980 comes to a different conclusion as do recent statements by other observers. (See app. 6A of this chapter for further discussion.) If a large demand for videoconferencing should materialize, perhaps stimulated by new satellite and cable competitors, demand for international communications could grow even more rapidly than the carriers' forecast.

The Satellite Communications Component

Will international satellite communications share in this rapid growth? Will it grow as rapidly as international telecommunications as a whole? The growth prospects for satellite communications are even more uncertain than those of the total industry. It is even possible that the growth of international satellite communications could level out in the 1990s at the same time as total international telecommunications was continuing to expand rapidly. This could occur if undersea cables, using advanced fiber optic technology, are used relatively more in the future than satellites.

Although international satellite communications can be expected to continue to grow rapidly in the 1980s,14 the prospects for the 1990s are much less certain. The s-hare of satellites in the 1990s will depend on:

- the growth in the total demand for international telecommunications services;
- the price advantage/market preference, if any, of fiber optic over satellite transmission for high-volume applications;[15]
- the strength of industry-structure and other incentives for carriers to invest in fiber optic undersea cables and use them in preference to satellites; and
- the actual growth of undersea cable capacity and the presence or absence of regulatory restrictions on its use.

Because all of these factors are uncertain, we organize the discussion of the demand for satellite communications in the 1990s in terms of three plausible scenarios:

1: Rapid growth throughout the 1990s.
Ii: Slow growth throughout the 1990s.
III: A *no-growth plateau* in the 1990s.

Essentially the three scenarios represent different outcomes of the modal competition between fiber optic undersea cables and communication satellites for international communications in high volume uses. If users and carriers have significant preferences in favor of fiber optic transmission, and if these preferences are not blunted by regulatory decisions to limit the construction or use of undersea cables, the employment of satellites on major trunk routes could decline significantly in the 1990s, **and total satellite communications use could level off. This would be more** likely to occur if international telecommunications as a whole did not grow as rapidly as the videoconferencing optimists expect. This is the no-growth scenario for satellite communications in the 1990s.

On the other hand, less preference for cables or more stringent regulation requiring carriers to use satellites could keep satellite communications carrying roughly the same 50 percent share of the growing transatlantic market as it does now. This would be the rapid growth scenario.

A slow growth scenario represents a trend midway between the other two scenarios.

Table 6-3 lists the key variables that are uncertain and the assumptions about them that would affect demand according to the three scenarios.

[13] Videoconferencing and audioconferencing (no video element) together comprise teleconferencing. Full-motion videoconferencing requires broadband telecommunications capability, but slow-scan videoconferencing (as well as audioconferencing) can be sent over standard telephone circuits.

[14] At least through 1%8, when the transatlantic *TAT-8* and transpacific Transpac 3 fiber optic cables are scheduled to be operational.

[15] High-volume applications refers to addressable communications, mostly telephone conversations, that are transmitted point-to-point, with international transit along major cable or satellite trunk routes. The growth of demand for services for which satellites are particularly suited—point-to-mu lti-point receive-only television transmission and low-density communications—will also be a factor, but a relatively unimportant one in *international* satellite communications than the growth of high-volume point-to-point applications because of the low total communications volume of the former.

Table 6-3.—Scenarios for Satellite Communications Demand in the 1990s

Key uncertain variables	Scenario I Rapid growth	Scenario II slow growth	Scenario III No growth plateau
Cost/price advantage/consumer preference for fiber optic transmission for high volume uses	SMALL	MODERATE	LARGE
	OR	*OR*	*OR*
Industry-structure incentives to adoption of fiber-optic cable transmission	LOW	MODERATE	HIGH
	OR	*OR*	*AND*
Growth in actual cable capacity or in capacity available under loading restrictions	SLOW-TO-MODERATE	MODERATE	RAPID

Note: These scenarios and assumptions are discussed in app. 6A of this chapter. This chart emphasizes the factors affecting the *share* of satellite communications. Slow growth In *total* international telecommunications demand would reduce the growth of satellite communications in all scenarios and make the growth plateau more likely.

The scenarios and the assumptions behind them are discussed in greater detail in appendix 6A of this chapter.

The International Satellite Communications Service Industry

A number of important issues **in U.S. international space and satellite communications policy are embedded** in the structure of the world telecommunications service industry. (Structure here refers to the prevailing modes of operation, ownership, and regulation in the industry.) The world industry and its structure are increasingly affected by the same technological developments—the merging of the data processing and telecommunications industries based on inexpensive computing power, digital communications, satellite networks, and other technical innovations–that contributed to the break-up of the regulated-monopoly structure in U.S. long-distance communications.[16] These developments are now affecting the telecommunications economies of a number of other industrial countries and are beginning to force structural change to occur there as well.[17]

Since the pace of change is greatest in U.S. telecommunications markets, conflicts with other countries in international satellite communications policy have been growing out of the conflicting desires and actions of U.S. and foreign telecommunications producers and consumers—both in the United States and other countries–as they respond to technology-driven changes in telecommunications markets. These market developments, rather than the initiatives of the U.S. or foreign governments, are the primary impetus behind current policy discussions in satellite communications.18

The Emerging Industry Structure in U.S. International Communications

Even though the United States has deregulated much of its domestic telecommunications, the old regulatory structures affecting U.S. *international* communications remain largely in place.[19] While the FCC has relaxed the distinctions between international and domestic and voice and record carriers,[20] this as yet has had little impact

[16]See Richard I. Kirkland, "Ma Blue: IBM's Move Into Communications," *Fortune*, vol. 110, Oct. 15, 1984, pp. 52-54,58,62. Also see Dante B. Fascell and Virginia M. Schlundt, "United States International Communications and Information Policy: A Crisis in the Making?" *Northwestern journal of International Law and Business*, vol. *5*, fall 1983, pp. 486-509.

[17]For a discussion of technological change as the leading edge of change in telecommunications regulation in the United States and other countries, see unpublished paper by Alan Baughcum, presented at the Research Workshop on Economics of Telecommunications, Information and Media Activities in Industrial Countries, National Science Foundation, Apr. 30-May 2, 1984, Washington, DC (forthcoming, North-Holland Publishing Co., 1985). Also see "America calling, " *Economist, Nov. 24, 7984,* pp. 97-98.

[18]For a general treatment of the problem of international conflicts of jurisdiction, see George Shultz, "Trade, Interdependence, and Conflicts of Jurisdiction, " Current Policy No. 573, May 5, 1984.

[19]See app. 6A for further discussion of how the international regulatory regime has changed in recent years.

[20]" Record" communications–telegraph, telex, and data—are conventionally distinguished from "voice' '-telephone-and from television transmissions.

on which firms carry what traffic and on how they do business internationally. AT&T Communications still carries almost all U.S. international telephone communications; the international record carriers, formerly restricted to record communications, still handle most of the record traffic; INTELSAT and COMSAT still have a virtual monopoly on U.S. intercontinental space-segment communications; and the FCC still oversees a process in which approved carrier consort~a plan facilities years ahead.

Nevertheless, pressed by regulatory and technological changes, the large firms, such as AT&T, IBM, GTE, ITT, RCA, Western Union, and COMSAT, have all started to penetrate each other's former preserves (or are contemplating it). New entrants have also been able to enter the international markets for both basic and enhanced telecommunications services.[21]

Several notable events have recently set the stage for the large telecommunications firms to start moving toward an undifferentiated international industry on the U.S. side:

- The Orion Satellite Corp., RCA, and other applications to the FCC in 1983, 1984, and 1985 to construct private transatlantic satellite facilities to be owned by individual firms.
- The FCC decisions to allow COMSAT to provide retail service and other carriers to independently own Earth stations transmitting to and receiving from INTELSAT satellites.[22]
- The success of Western Union Telegraph Co.[23] in penetrating the international record market and the moderate success of MCI and GTE in penetrating the international telephone market.
- The emergence of a Western Hemisphere regional system based on the satellites owned individually by U.S. private domestic satellite providers and by Telesat Canada.
- Finally, the plans announced in 1984 by: 1) Cable'& Wireless, Ltd., a British firm, and its U.S. partners;[24] and 2) Submarine Lightwave Cable Co. (SLC),[25] a U.S. entrepreneurial group, to install new very high-capacity, transatlantic fiber optic cables.[26]

Because data processing and telecommunications firms can no longer easily be separated into different industries, and telecommunications providers themselves are no longer segmented into the traditional rigid regulatory categories, the in-

[21] In early 1985, the FCC was moving toward making entry even easier by relaxing the procedural requirements for all but "dominant" carriers (those having significant market power). In the course of this process, it has tentatively concluded that, except for the local telephone carriers in Alaska, Hawaii, and Puerto Rico, only AT&T (in message telephone service) and COMSAT are dominant carriers and therefore have to be closely regulated. (FCC, "In the Matter of International Competitive Carrier Policies, " File No. 85-177, released Apr. 19, 1985.)

[22] The FCC authorized COMSAT to compete directly with other carriers for customers' business in 1982, but the U.S. Court of Appeals for the District of Columbia suspended action until the FCC resolved other matters, including the issue of Earth stations and direct ownership-type access to the INTELSAT system by carriers other than COMSAT. (U.S. General Accounting Office, *FCC Needs to Monitor a Changing International Telecommunications Market,* RCED-83-92, Mar. 14, 1983.) In a series of decisions culminating in an order released in January 1985, the FCC reaffirmed its policy to allow COMSAT to provide retail service (through a subsidiary separate from the monopoly World Systems Division), denied carriers ownership-type access to INTELSAT, but allowed them and other users to own their own Earth stations communicating directly with INTELSAT satellites (FCC, "Second Report and Order in the Matter of Proposed Modification of the Commission's Authorized User Policy Concerning Access to the International Satellite Services of the Communications Satellite Corporation," released Jan. 11, 1985).

[23] Western Union Telegraph Co., formerly the de facto monopoly domestic record carrier, should not be confused with Western Union International, a separate firm, one of the traditional record carriers and now a wholly owned subsidiary of MCI Corp.

[24] Application of Tel-Optik Ltd. (Cable & Wireless' U.S. partner) for a license to land and operate in the United States a submarine cable extending between the United States and the United Kingdom, FCC File No. S-C-L-84-002, Sept. 28, 1984.

[25] Application of submarine Lightwave Cable Co., FCC File No. SCL-85-001, Oct. 16, 1984. Submarine Lightwave's FCC filing says that the cable would provide 250,0(X voice circuits for telephony or 72 broadcast-quality video channels, if used entirely for those purposes; it would cost $450 million, and would be installed in 1989. The application also states that the cable may in its final design result in even more usable capacity, since "current technology is developing extremely rapidly" (p. 2).

[26] In March 1985, the FCC informed the Secretary of State of its conclusions that the Tel-Optik application "meets the threshold reciprocity showing of the Cable Landing License Act and otherwise appears to be consistent with U.S. interests under the Act. " The SLC application was not acted on pending the receipt of additional information. (FCC News, Report No. 3092, Mar. 4, 1985). In May 1985 (based on an April refiling by SLC), the FCC recommended to the State Department that it also approve the SLC cable landing license (letter from Mark S. Fowler to William Schneider, Jr., May 16, 1985). The Tel-Optik cable landing license was approved by the FCC on May 16, 1985, subject to conditions that it is revocable after due notice of hearing and that it is subject to future modification by the Secretary of State "to protect U.S. interests as a result of the sale or lease of capacity to particular foreign or domestic entities" ("In the Matter of Tel-Optik Ltd. Cable Landing License, " FCC Mimeo 461 8).

ternational telecommunications industry is described broadly in this report and the formerly important distinctions between telephone and telegraph, terrestrial and satellite, enhanced and basic, international and domestic, and international and transborder are not emphasized.

Participants in the U.S. International Satellite Communications Market

Of all the U.S. firms participating in international communications, AT&T is still the largest with $38.7 billion in (postdivestiture) total assets in 1984. IBM, GTE, ITT, MCI, RCA, McDonnell Douglas, Western Union, Continental Telephone, United Brands, and COMSAT are also among the largest U.S. firms. Not all of them (e.g., McDonnell Douglas, Continental Telephone, and United Brands) currently have a large participation in international telecommunications, but each is in a competitive position to expand their already significant activities should they so choose. (See table 6-4 for a listing of U.S. international communications firms.)

In addition to these firms, the list of potential new entrants into international satellite communications is large and growing. It includes both other owners of satellites used in U.S. domestic communications (e.g., Hughes Aircraft Co.[27] and Ford Motor CO.[28]) and those that lease or buy transponders from them. Several potential entrants are new corporations organized to provide international satellite capacity.

In addition to firms that sell or plan to sell telecommunications services, a growing number of other large U.S. multinational firms have put together very large private international communications networks, notably Citicorp (connecting 1,400 offices in 93 countries), General Electric, Merrill Lynch, Shell Oil, and Texas Instruments, that use the private-line and public services of authorized telecommunications carriers (see figs. 6-1 and 6-2).[29] Through resale of excess capacity, many of them have become telecommunications

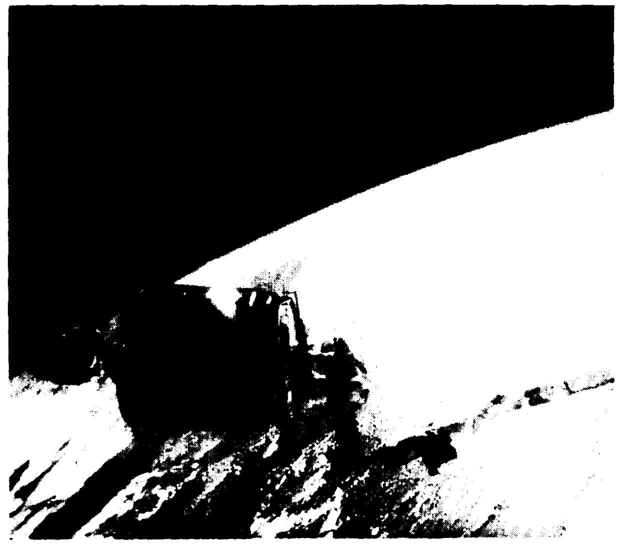


Photo credit: National Aeronaut/es and Space Administration

Westar Vl, communications satellite built by Hughes Aircraft Co., being retrieved by Shuttle astronauts on mission 51-A after it failed to achieve geostationary orbit. The astronauts are to the left and right of the satellite. An astronaut on board controls the remote manipulator arm to bring the satellite into the Shuttle bay.

providers in the U.S. domestic market, and if permitted, could participate in the international market as well.

As the international regulatory regime[30] for telecommunications is currently structured, U.S. international service carriers must hand off communications traffic to foreign telecommunications carriers for entry into other countries. Table 6-5 presents a list of the major carriers of satellite communications outside the East European bloc; these are the officially designated representatives of their countries ("signatories") to INTELSAT. The PTTs of Germany and France are both large entities, as are the PTTs of a number of other countries. They own most of the telecommu-

[27] Through its Hughes Communications, Inc., and Hughes Communications Galaxy, Inc., subsidiaries.

[28] Through its Ford Aerospace & Communications Corp. and Ford Aerospace Satellite Services Corp. subsidiaries.

[29] Department of Commerce, *U.S. Industrial Outlook 1984*, pp. 46-48.

[30] We use the term "international regu latory regime' (or "international communications regime") broadly to include all governmental and intergovernmental actions affecting the operations of the international communications carriers. These include treaties and other formal and informal intergovernmental agreements in the area of telecommunications, other elements of international law affecting telecommunications, the actions of international organizations such as the ITU or INTELSAT, and the actions of national governments that affect the international telecommunications industry.

Table 6.4.—U.S. Telecommunications Firms Providing international Satellite Communications Services

Salected *major* U.S. corporations currently authorized to *provide International service to consumers, directly or through one or more subsldlarie~*	Assets *Dec. 31, 1984 ($ mIllIon)*
International Business Machines Corp. (Satellite Business Systems)[bcde]	42,808
American Telephone and Telegraph Co. (post-divestiture)[cdf]	38,826
GTE Corp. (GTE Sprint Communications GTE Spacenet Corp., Hawaiian Telephone Co., GTE Telenet Corp[cde])	26,364
IIT Corp. (ITT Worldcom, U.S. Transmissions Systems, Inc.)[df]	13,277
RCA Corp. (RCA Globcom, RCA Americom)	8,221
McDonnell Douglas, Inc. (FTC Communications, Inc., FTC Satellite Systems, Inc., Tymshare, Inc., Tymnet, Inc.)[dfh]	6,191
Continental Telecom, Inc. (American Satellite and Space Communications Co., joint venture with Fairchild Industries[cd]	4,557
MCI Communications Corp. (Western Union International, Inc.)[f]	3,894
Hughes Aircraft Co. (Hughes Communications, Inc., Hughes Communications Galaxy, Inc.)[cde] Q	*3,500'*
Western Union Corp.[cef]	2,259
Federal Express Corp. (Fedex international Transmission Corp.~	1,526
Communications Satellite Corp. (COMSAT International Communications, COMSAT General Telematics, Inc.)[dk]	1,166
United Brands Co. (TRT Telecommunications, Inc., International Satellite, Inc., Pacific Satellite, Inc.)[def]	1,024
Fairchild Industries, Inc. (American Satellite and Space Communications Co., joint venture with Continental Telecom)[cd]	948

aPartial list of other U.S. telecommunications corporations participating in or intending to participate in international satellite communications service markets: Advanced Business Communications, Inc., Atlantic Transport Co., Bonneville Satellite Corp., Compact Video Services, Inc., Cygnus Satellite Corp., Eastern Microwave, Inc., Equatorial Communications Services, Inc., Financial Satellite Corp., Graphnet, Inc., International Relay, Inc., Intelmet, Inc., Koplar Communication, Inc., Metromedia, Inc., Midwest Cable and Satellite, inc., NEP Communications, Inc., Netcom International, Orion Satellite Corp., Pan American Satellite Corp., Rainbow Satellite, Inc., Reuters Ltd., Satellite Gateway Communications, Inc., Sunbeam Television Corp., Taft Television and Radio Co., Inc., Turner Teleport, inc., United Video, Inc., Videastar Connections, Inc., Visions, Ltd., Vitalink Communication Corp., World Telecommunications Corp., 220 Television.

bSatellite Business Systems (SBS) is a joint venture with Aetna Life and Casualty Co. as of December 1984. IBM owned 60 percent of SBS and with Aetna owning the remainder. COMSAT, an original partner in the joint venture sold its holdings to the other two partnera.

cCurrently authorized to provide satellite communications service to specific North American countries.

dAuthorized t. receive INTELSAT Business Service using its own earth station facilities and satellite circuits leased from COMSAT.

eApplication to provide capacity for specific transatlantic, transpacific or Western Hemisphere satellite Services pending at the FCC.

fEstablished U.S. International Service Carrier.

gApplication to provide specific North and South American international services conditionally approved by the FCC pending INTELSAT coordination procedure.

hFTC Communications, Inc., is *20* percent owned by the French Government, 80 percent owned by McDonnell Douglas.

iThis figure is the mid-point of the range of estimated market value by "Wall Street sources" of this privately held corporation for the New York Times (Jan 11, 19S5, P. D3).

jAuthorized to provide transatlantic document transmission service.

kU.S. INTELSAT signatory.

SOURCE: *Fortune* (Apr. 19, June 10, 19S5), Financial Statements, Moody's Manuals and News Reports, FCC documents.

nications assets of their countries.[31] British Telecom, slightly more than half of which was sold to private stockholders in November 1984, remains the preponderant British domestic and international carrier and is the U.K. INTELSAT signatory. Kokusai Denshin Denwa (KDD), Japan's officially designated international monopoly carrier, is both a regulated private firm and the INTELSAT signatory for Japan.

INTELSAT is the final element in the international industry. At the end of 1983, it had assets of $1.6 billion .32 Like most of the participants in the international telecommunications service industry, INTELSAT provides communications services (in this case, space-segment capacity) in both international and domestic markets.[33] INTELSAT

[31] For instance, the PTT of France, Direction General des Telecommunications, had year-end 1983 assets of FF 164 billion, about $20 billion (source: telephone conversation with France Telecom, Inc. (New York), October 1984).

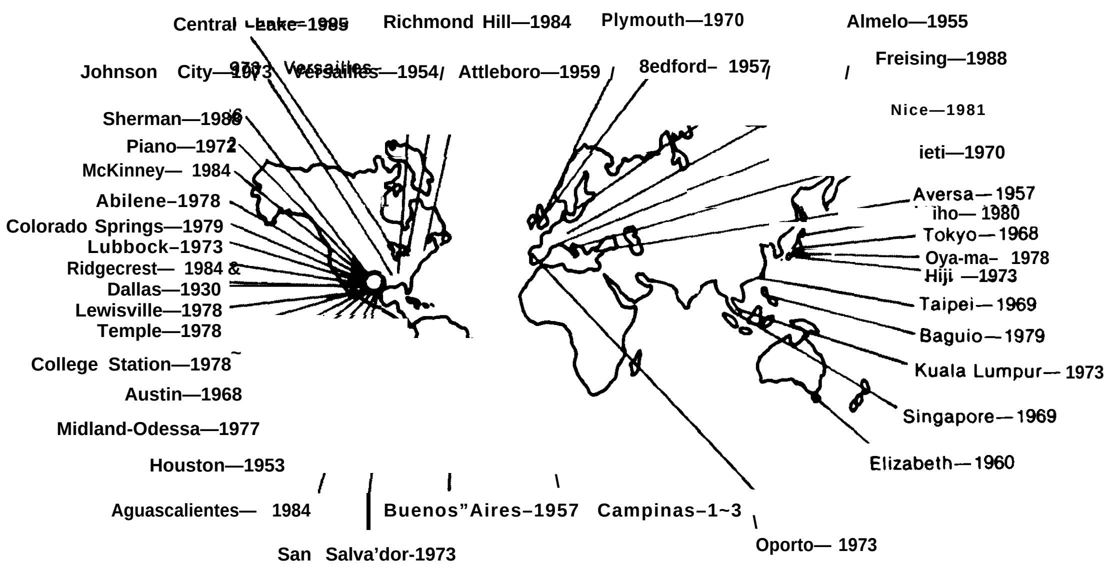
[32] INTELSAT Financial Statements, Contribution of the Director General to the Board of Governors Meeting, BG-58-70E W/3/84, Feb. 10, 1984.

[33] INTELSAT participates in the domestic markets of a number of countries by leasing transponders for domestic service to telecommunications entities, usually its signatory-owners. It also provides a small fraction of its space-segment capacity to non-owner gov-

Figure 6-1 .—Texas Instruments' Worldwide Data Communications Network

Information systems and services

TI worldwide plant locations



— Location and date connected

Texas **Instruments' worldwide data communications and electronic mail network is an illustration of the current possibilities for multinational communications networks. It grew to its present configuration over three-decades,** as domestic and overseas locations were linked by telecommunications. This shows TI's overseas plant locations and the dates they were linked to the TI corporate network. Exchange of detailed production, engineering and financial data is routine and allows the corporation to effectively coordinate worldwide manufacturing operations. Computer-assisted design capabilities in the system also allow engineers and managers at any location to use the firm's extensive computer capabilities in the United States

SOURCE: Texas Instruments.

serves as both a communications enterprise with commercial goals and an international organization with important noncommercial goals.

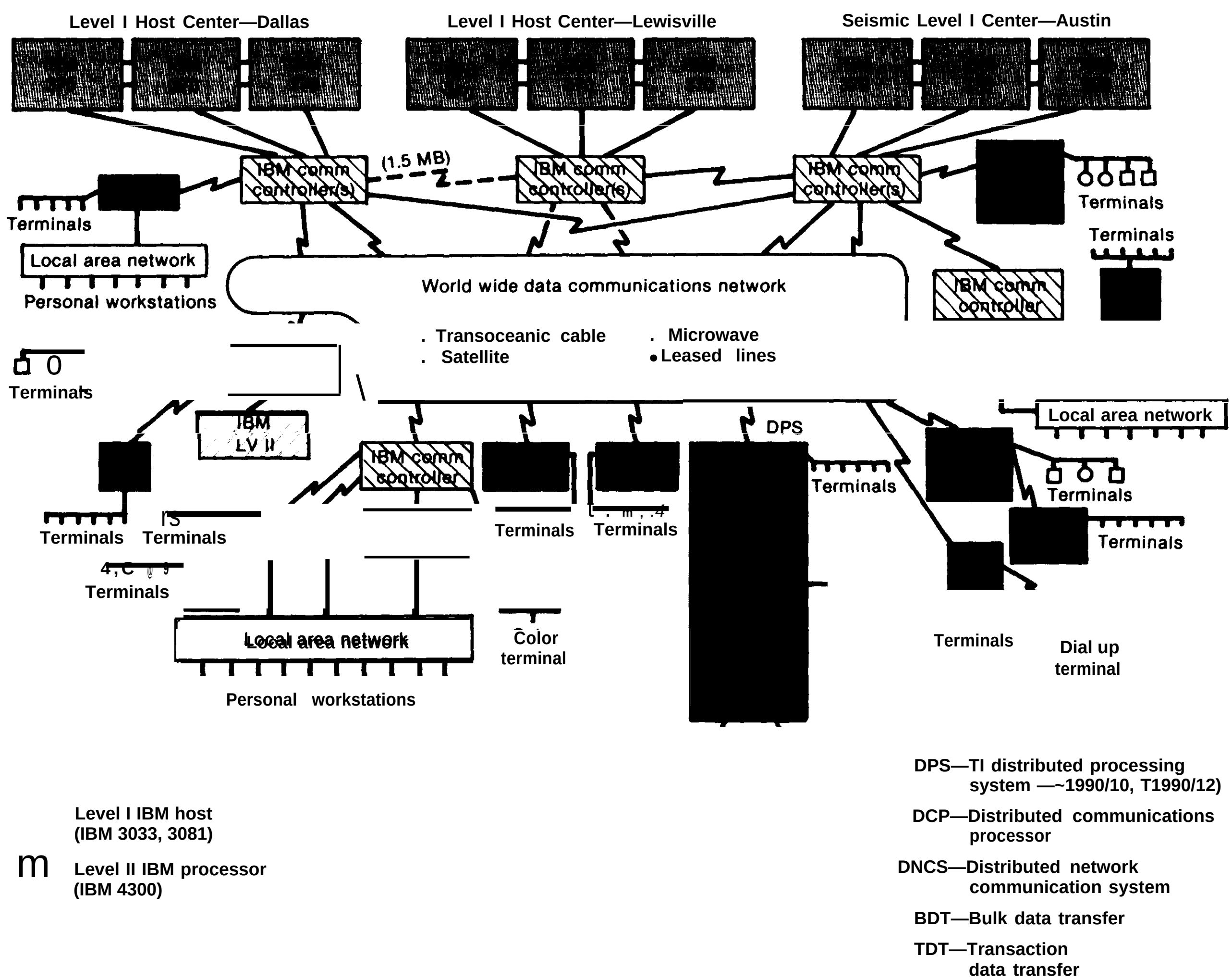
ernments, such as the Soviet Union. How to characterize INTELSAT has become an element in the policy debates involving INTELSAT and COMSAT. INTELSAT and COMSAT and those supporting their positions often denote INTELSAT as a "cooperative" of owner-members. Others, in opposition to these positions, who wish to emphasize the price—and capacity-setting aspects of the organization, often characterize it as a "monopoly" or a "cartel" composed of COMSAT and the PTTs. To attempt neutral terminology in this report, we refer to it as a "consortium" or an "international organization" as appropriate.

Competition in the United States Among International Communications Firms

The major U.S. participants in international satellite communications are the same firms that dominate the massive U.S. domestic telecommunications industry. As we have noted, other large corporations would also be able to compete in all segments of a deregulated international market, should they choose to or be allowed to enter.[34]

Entry is likely to take place in those areas with the highest profit rates. This applies to both domestic and international markets. Although most domestic market segments are now contestable, in the sense that firms are free to enter, firms will pick and choose carefully for actual entry among the richly differentiated opportunities in the communications and information industries that are available.

Figure 6-2.—Texas Instruments' Information Network Concept



This figure schematically displays some of the characteristics of Texas Instrument's system and shows how it is controlled and linked.

SOURCE: Texas Instruments.

An important point to make is that competition among U.S. firms takes place not only in the services and facilities markets but also in the financial markets. Firms that are successful in attracting funds are able to expand more rapidly into opportunities that become available than firms that attempt to deter entry into their traditional preserves through a strategy of keeping their prices and profits low. This second dynamic (competition in financial markets) will affect the

Table 6-5.—Members of INTELSAT: The Major Non-U.S. Telecommunications Providers of International Satellite Communications Services

Country	Signatory	Investment share[a] (percent)
Total nine countries with 3 percent or more:		*60.7*
United States of America	Communications Satellite Corp.	23.1
United Kingdom	British Telecommunications	12.9
France	Government of France	5.6
Japan	Kokusai Denshin Denwa Co. Ltd.	3.3
Germany, Federal Republic of	Ministry for Post and Telecommunication	3.3
Australia	Overseas Telecommunications Commission	3.2
Saudi Arabia	Government of Saudi Arabia	3.1
Brazil	Empresa Brasileira de Telecomunicacoes S.A.	3.0
Canada	Teleglobe Canada	3.0
The Other 99 INTELSATMembers:		39.3

[a]Asof Mar 1, 1964.

SOURCE: INTELSAT. See app. 6C, for a complete listing of the members of INTELSAT and their investment shares.

speed with which the old specialist structures remaining from the era of tight regulation break down and new specializations based on competitive advantage emerge.

Foreign competition in U.S. long-distance telecommunications (in both domestic and international market segments) is also a possibility now that the U.S. market is substantially deregulated. At least one foreign firm is currently seeking to enter in a substantial way. Cable & Wireless, a British firm with some U.K. Government ownership, is reputed to be planning to enter the U.S. domestic long-distance telecommunications market by constructing an extensive fiber optic cable network laid on railroad rights of way.[35] It is quite possible that telecommunications firms from other countries will also enter in the future. Cable & Wireless, in joint venture with U.S. investors, has also applied for and received a cable landing license for a high-capacity transatlantic fiber optic cable facility (six fiber pairs) between the United States and the United Kingdom.[3b] A Cable & Wireless subsidiary has already established service between the United States and Canada. s'

It may be somewhat difficult for European government-owned PTTs to compete directly in the U.S. market (selling domestic and international communications services directly to U.S. consumers) without undercutting the diplomatic justifications they make for preserving their monopolies at home.[3e] Nevertheless, the French PIT has designed its transatlantic satellites Telecom I and Videosat III with footprints (transmission area) that include the Eastern United States. (Any intent to use them for transatlantic international communications other than to reach French territories is denied by French telecommunications officials. [39]) Self-imposed restraints may not be as binding for certain foreign private telecommuni-

[35]Cable & Wireless has discussed the possibility with a number of U.S. railways. (Department of Commerce, *U.S. Industrial Out-/ook 1984,* pp. 46-51). Rights of way along highways, gas or oil pipelines, and electric utility transmission lines may also be usable ("Golden Opportunity, Can Utilities Move Fast Enough to Cash in On the Telecommunications Boom?" *The Energy Daily, Nov.* 16, 1984.) Mercury Communications, the new entrant in U.K. domestic telecommunications, is a wholly owned subsidiary of Cable & Wireless, Ltd.

36 Application of Tel-Optik Ltd. (Cable & Wireless' U.S. Partner) for a license to land and operate in the United States a submarine cable extending between the United States and the United Kingdom, op. cit.

37FCC, "IntheMatter of TDX Systems, Inc. . ., File No. ITC 85-077, Mimeo No. 3604, released Apr. 3, 1985. TDX Systems, Inc. is a wholly owned subsidiary of Cable & Wireless.

[38]This reticence may not be as strong in enhanced (computer-processed) communications services, and entry via INTELSAT Business Services will be easy (Eli M. Noam, "Telecommunications Policy on the Two Sides of the Atlantic: Divergence and Outlook, " op. cit., p. 16).

[39]The stated justification for the Telecom I satellite is to Com municate with a French island territory in the Atlantic off of Canada and French territories in the Caribbean, but there would be no technical reason why it or the successor satellite Telecom I B, scheduled to be launched in March 1985, could not be repositioned to offer competition to INTEL5AT or entry into the U.S. market (source: telephone conversation with France Telecom, Inc., October 1984). See also "French PTT Chief, COMSAT Deny Telecom 1 Will Compete With INTELSAT, " *Satellite News, Nov.* 5, 1984. There has also been a January 1985 French filing with the IFRB for the Videosat satellite, whose footprint will include most of the Eastern United States.

cations firms like KDD,[40] Japan's international carrier, however, since they are not government corporations. Cable & Wireless has led the way, but now that British Telecom has been taken private, it may also become more aggressive. Similarly, Britain's Unisat satellite (launch date 1986), which like the French satellites has a footprint covering parts of North America,[41] may not be constrained from competing for U.S. business by its minority government ownership.

In sum, in the highly competitive, new U.S. telecommunications industry, very large U.S. domestic telecommunications and data processing firms, as well as a full range of large, small, and foreign new entrants, are in actual or potential competition with each other for both domestic and international communications opportunities. AT&T may be able to keep its present dominance in domestic long-distance telephony in the new domestic market, but it will do so only by competitive success. In the long run, technological and economic forces, which are affecting regulatory structures in the national markets of other countries, as well as in the United States, appear likely also significantly to expand opportunities for firms other than AT&T in international communications service markets.[43] For the present, however, powerful barriers to change in foreign countries are still limiting these opportunities.

Competition in Foreign Telecommunications Service Markets

In "basic" telecommunications services,[44] international competition in foreign markets is practically nonexistent. Most countries outside the United States do not allow competition even in domestic long-distance telecommunications; a telecommunications monopoly, owned by the government (or, alternatively, in some cases a private monopoly regulated by the government) is the prevailing mode of industry organization around the world. While a few countries, notably the United Kingdom, Japan, and Canada, are moving toward privatization and limited domestic competition, they do not as yet envisage competition from foreign (including U. S.) firms. Foreign carriers must transfer control of communications passing into (or through) the country to the PTT at the international border or to an intermediate cable or satellite consortium that subsequently passes control to the PTT.

In contrast, at the information services end of the information/communications continuum, U.S. and foreign firms, which provide interactive data processing services, compete in many national markets. For regulation to have practical effect, a boundary has to be drawn somewhere between the regulated basic communications industry and the unregulated data processing industry, since they merge into each other. Unlike the present situation in the United States, in most countries, the telecommunications entities attempt to monopolize enhanced communications and value-added network (VAN) services, which increase the efficiency of communications in private networks. (This latter technique uses computer processing to group communications into packets going to common destinations.) In a few countries, private firms, including U.S. ones, are allowed to compete freely in providing these serv-

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[40] KDD is formally a private stock company traded on the Tokyo Stock Exchange. The private status of KDD can be overemphasized, however. Very strong Japanese Government influence enters not only through regulatory channels, but also because large blocks of stock are owned by government employee pension funds and other government employee organizations.

[41] Departments of State and Commerce, "A White Paper on New International Satellite Systems," op. cit., p. 25.

[42] British Telecom, which had previously been separated from the postal administration, underwent majority privatization Nov. 28, 1984, and is facing limited domestic competition from Cable& Wireless' domestic subsidiary (Mercury Communications) and from enhanced service providers. The expectation that the European PTTs will not enter the domestic U.S. telecommunications market is also subject to some question. Several European state-owned enterprises have entered the U.S. market in other industries. For instance, Renault, a French state-owned auto company has a relationship with American Motors, various European state-owned airlines have effectively competed for U.S.-origin airline passengers, and several state-owned banks have established active branches in the United States.

[43] One such technological force impelling change concerns telecommunications equipment. Developments in customer-premises communications equipment and in computers have undercut regulatory rules that require customers to acquire such equipment only by leasing or purchasing it from their telecommunications carrier. Private purchase and interconnection of telecommunications equipment to the public network have been permitted in the United States since the 1970s and are now allowed in a variety of other countries. (See Del Meyers, Janice Drummond, and Czatdana Inan, "World Telecom Spending to Reach $78.5 Billion This Year," *Telephony*, Feb. 28, 1983, p. 43.)

[44] I e., ordinary voice, record, data, and television transmission, where computers are not used to process the communications flow.

ices. (See app. 6A for a discussion of the international regulatory regime.)

International Facilities Competition

Control of international communications sent between adjacent countries by land cable, undersea cable, or terrestrial microwave passes bilaterally at the border from one country's carrier to the other country 's. In certain cases, however, governments and carriers have devised mukilateral mechanisms of joint ownership for international satellites and transoceanic cables (described further in app. 6A). INTELSAT and INMARSAT are two such consortiums of international carriers, and there are transatlantic and transpacific cable consortiums that are jointly owned by U.S. and Canadian carriers, on the one hand, and European or Asian carriers, on the other.[45]

As in the provision of basic international telecommunications *services,* competition among firms in the provision of international transmission *facilities* is also almost universally not allowed. The closest thing to competition in international facilities in the current regulatory regime is the competition between INTELSAT and the various transatlantic cable consortia. Even this competition is largely managed by overlapping PTT representation in INTELSAT and the consortia, by U.S. regulatory policies encouraging the "balanced" use of both kinds of facilities, and by facilities planning processes overseen by the FCC and other regulatory authorities.[46]

Recently, these arrangements have been challenged by the would-be private transatlantic and Western Hemisphere satellite and cable operators referred to above. These potential entrants have received qualified official encouragement from either the FCC, the executive branch, or both. As we discuss below and in appendix 6A, the capacity additions specified in these applications, together with INTELSAT's planned additions and the cable facilities discussed within the official planning process, are far in excess of the 1995 communications demand projected by the U.S. international service carriers and their European counterparts.[47] This would appear to call into serious question the FCC planning process and/or the demand projections of the carriers.

The Satellite Communications Equipment Industry

The large-scale development of the world satellite communications service industry has been made possible by the development of a large satellite communications equipment industry, particularly in the United States. Despite severe trade restrictions and growing industrial policy chal-

[45] U.S. carrier participation in INTELSAT and INMARSAT is through COMSAT alone, in its role as a carriers' carrier, in contrast to the cable consortiums to which most U.S. service carriers belong.

[46] "Balanced use," as used in this report, means the substantial use of both satellites and cables, without specifying exactly how this is to come about. At various times in the past, the FCC has used several formulas to balance the use of satellites and cables through regulation, including "proportional fill," "50-50," and "balanced loading." The loading methodology currently in use was negotiated among AT&T, COMSAT, and the European PTTs on a country-by-country basis and approved by the FCC. It is generally "in accordance with what is known as the 'balanced loading' methodology," defined by the FCC as the "distribution of circuits among facilities with unused capacity in a manner which, to the extent possible, seeks to place equal numbers of circuits on all transmission systems" [emphasis added] (Federal Communications Commission, "Second Notice of Proposed Rulemaking in the Matter of . . . Authorization of Common Carrier Facilities to Meet North Atlantic Telecommunications Needs During the 1985-1995 Period," FCC 85-176, released Apr. 22, 1985, p. 3). See below and app. 6A for further discussion of facilities regulation.

[47] For transatlantic communications the FCC has received applications to install satellite capacity of about 120,000 circuits and fiber optic cable capacity of about 330,000 circuits in addition to the proposed capacity additions of the traditional consortia listed in table 6-A2 in app. 6A. See also discussion of alternative satellite providers below and in app. 6A. The additional 330,000 circuits of cable capacity, for which cable landing licenses have been applied, are in the cable projects of Cable & Wireless and its U.S. partners (Tel-Optik) and Submarine Lightwave Cable Co., which are for 80,000 and 250,000 circuits, respectively.

lenges from Japan and Europe, U.S. manufacturers continue to dominate world sales of communication satellites. U.S. ground equipment manufacturers, however, no longer dominate the world market for large standardized Earth stations, and though they still lead in the market for small Earth stations designed for customer premises, they are beginning to receive strong foreign competition there as well, [48]

World Satellite Markets

For the satellite manufacturing industry, the non-Communist world market can be conveniently divided into five parts: the United States, INTELSAT, Canada, Europe and Japan considered together, and the rest of the world. During the 1965-83 period, INTELSAT was the largest of these markets, with 35 satellites launched, followed by the United States with 26 (as shown in table 6-6). U.S. prime contractors manufactured all 72 of the commercial communication satellites sold outside of Europe and Japan during the 1965-83 period. In contrast, European and Japanese contractors produced only the eight satellites launched for European and Japanese buyers during the same period and sold none outside of these reserved markets. In the case of the Japanese satellites placed in orbit, a U.S. company provided many of the components and provided technical assistance.

In the 1984-89 period, for satellites whose prime contractors have already been announced, the pattern is similar, with the one important exception that the United States is expected to be by far the largest single market, with 53 percent of the scheduled satellites during this period (see table 6-6). U.S. satellite buyers are of several types: private communications firms such as AT&T, Western Union, COMSAT, GTE, Federal Express, and IBM's Satellite Business Systems (SBS) subsidiary, direct broadcasters (e.g., Dominion Video Satellite Corp.), and several smaller and newer firms that provide specialized satellite facilities to business and media customers (e.g., American Satellite). The three major U.S. satellite manufacturers–Ford, RCA, and Hughes—have also launched, or plan to launch, their own satellites for lease or self-use. RCA plans to use its satellites in its own common carrier operations,

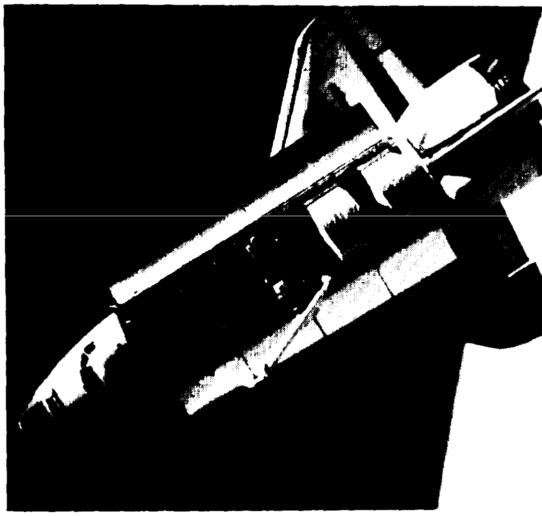
[48] Customer premises Earth stations can be defined as stations which are located at the point of use.

Table 6-6.—U.S. Market Share of Commercial Satellite Prime Contracts

Buyer	Number of satellites					
	Seller					
	United States	Canada	Western Europe	Japan	No prime selected	Total
1965-83:						
United States	26					26
INTELSAT	35					35
Canada	6	I(I)				7
Western Europe			5			5
Japan				3(3)		3
Other	5					5
Total	72	I(I)	5	3(3)		81
1934-39:						
United States	*40*				*40*	*80*
INTELSAT	*20*					*20*
Canada	1	4(1)				5
Western Europe			19			19
Japan				8(4)		8
Other[b]	9	2(2)	2(2)		5	18
Total	*70*	*6(3)*	*21(2)*	*8(4)*	*45*	*150*

NOTE: Numbers in parentheses refer to the number of satellites manufactured by foreign prime contractors but with major U.S. participation.
[a] Indonesia, Italy, India.
[b] Indonesia, Arab States, Mexico, Australia, Brazil, India, Korea, Argentina, Cuba.

SOURCE: Derived from R. Filep, A. Schnapf, and S. Fordyce, "World Communications Satellite Market Characteristics and Forecast," prepared for the NASA Lewis Research Center, NASA CR-188270, November 1983. Non-Communist countries only are included in the list given here.



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both domestically and internationally, and all three either lease facilities to other firms now, or plan to.

In the rest of the world, the buyers are almost always governmental entities such as the Indonesian and other ASEAN[49] PTTs, for the Palapa series, or the Arab League consortium of PTTs for Arabsat.

For the period 1984-89, all sales of communications satellites to U.S. buyers and to INTELSAT (where prime contractors are known) have gone to U.S. prime contractors.[50] All 19 of the European contracts went to European contractors, and all 8 of the Japanese contracts went to Japanese contractors (see table 6-7). U.S. satellite manufacturers will still participate in major ways in four of the eight Japanese satellites to be launched during this period, but the other four will be manufactured by Japanese firms without the formal association of an American satellite manufacturer and will use key components of Japanese design.[51] In the rest of the world in the 1985-89 period, U.S. manufacturers are the prime contractors for, or have major involvement in, all but three of the satellites with announced contractors. These three satellites are being built by a Canadian prime contractor (Spar) for Canadian buyers.

Although the United States continues to dominate markets where competition is allowed, it should be noted that Canadian, European, and Japanese manufacturers are now able to build significant numbers of satellites without major U.S. involvement, albeit within the confines of protected markets. European and Japanese capabilities have grown even more at the component level, U.S. manufacturers were awarded the prime contracts for the current (INTELSAT V and V-A) and the next (INTELSAT VI) generation of INTELSAT satellites, but non-U.S. subcontractors received contracts for 23 and 21 percent, respectively, of the contract value of the two satellite series.[52]

Satellite R&D

Even though NASA funded relatively little communication satellite research and development during the 1973-83 period, U.S. market dominance persisted. U.S. industry was relied upon to finance its own R&D efforts. During the same period, however, foreign government-funded satellite communications R&D increased substantially. At present, the governments of Japan, Canada, United Kingdom, France, Germany, and Italy; the European Space Agency; and INTELSAT are all funding significant satellite communications research programs.[53] This imbalance in government R&D support led to concern in the United

[49] Association of Southeast Asian Nations.

[50] Contractors had been selected, however, for only 40 of the 80 announced US. satellites. Whether they will all be built will depend on whether sufficient demand for U.S. domestic satellite communications services develops.

[51] R. Filep, A. Schnapf, and S. Fordyce, "World Communications Satellite Market Characteristics and Forecast," prepared by Communications 21 Corp., Redondo Beach, CA, for the NASA-Lewis Research Center, Cleveland, OH, NASA CR-1 68270, November 1983.

[52] Filep, et al., op. cit., p. 101.

[53] See R. Filep, A. Schnapf, and S. Fordyce, "Japanese and Western European Space Research and Development," unpublished paper prepared for NASA Lewis Research Center, Feb. 1, 1984. See also U.S. Congress, Office of Technology Assessment, *Information Technology R&D: Critical Trends and Issues,* OTA-CIT-268 (Washington, DC: U.S. Government Printing Office, February 1985), ch. 7.

Table 6-7.-Prime Contractors for Commercial Communications Satellites (by launch period)

Company	Country	Actual 1985-83	Planned 1984-89
Prime contractor:			
[First launch 1983 or before]			
Hughes Aircraft	United States	45	33
Ford Aerospace	United States	10	10
RCA Astro-Electronics	United States	9	27
TRW Defense and Space Systems	United States	8	0
British Aerospace Dynamics	United Kingdom	4	9
Melco/Ford Aerospace	Japan/United States	3	1
C.N,S.	Italy	1	
Spar Aerospace/Hughes Aircraft.	CanadaWnited States	1	:
Total		81	84
Additional prime contractors:			
[First launch 1984 or later]			
Eurosatellite	West European Consortium		5
Melco (Mitsubishi Electric Co.).	Japan		4
Toshiba/GE	Japan/United States		3
Spar Aerospace	Canada		3
Matra Space	France		2
Aerospatiale (with Ford Aerospace)	France/United States		2
Siemens/MBB/ERNO/AEG/ANT	West European Consortium		2
Total			21
Pr/rne contractor not yet ***selected:*** [a]			45
Grand total		81	150

aFo, the period "Beginning of 1990" Through "The End of 1999, " 18 prime contractors have been selected (Of which 11 are U. S.) for specific satellites. During this same period, 149 satellite projects as yet have no prime contractor selected.

SOURCE: Derived from R. Filep, A. Schnapf, and S. Fordyce, "World Communications Satellite Market Characteristics and Forecast," prepared for the NASA Lewis Research Center, NASA CR-188270, November 1983. Non-Communist countries only are included In the list given here.

States that the United States could be behind in the technology of the next generation of communications satellites and was a prime motivation for Congress funding NASA's Advanced Communication Technology Satellite (ACTS) program at higher levels in fiscal year 1985 than previously.[54] (See below for further discussion of the ACTS program.)

Competitive Factors in International Satellite Markets

The price/quality dominance of U.S. manufacturers has been the most important competitive factor in both the U.S. domestic market and in INTELSAT contracts. Even the strong dollar has not hampered their recent successes. Other competitive factors helping U.S. firms are their well-known experience and the operational reliability of their satellites.

Protection and discriminatory government procurement are major factors segmenting world satellite markets and are the major factors determining sales of satellites in Europe and Japan. European and Japanese space development policies have included restrictions on procurement of complete satellites in order to favor national development of space technology.[55] Recent policy changes, however, may make possible the sale of U.S. communications satellites in Japan.[5b]

World Earth Station Markets

In contrast to the relatively small number of satellite manufacturers, more than 25 sizable firms

[54] Chris Bulloch, "Advancing the Art of Satellite Communications—Foreign Competition Spurs NASA Satcom Research," *Interavia*, January 1985, pp. 25-28.

[55] "Japan's Satellite Development Program," Japan Economic Institute Report, Washington, DC, No. 11A, Mar. 16, 1984 and "Aerospace in Japan: Competition Through Partnership," *Aerospace America,* March 1985, pp. 68-70. See also Neil Davis, "Japan Broadens Domestic Role in Satellite Development, " *Aerospace America,* February 1985, p. 27.

[56] See "New Trade Policy May Boost Japanese Imports of Satellites, " *Aviation Week and Space Technology,* May 7, 1984, p. 16; and William Chapman, "Japanese Trade Plan Seems to Open Door for U.S. Satellite Sales," *The Washington Post,* Apr. 28, 1984, p. A20.

in 7 countries manufacture Earth station equipment (see app. 6B). The equipment for an Earth station is diverse and includes antennas, tracking systems, amplifiers, ground communication equipment, multiplex equipment, and, for larger installations, support buildings and equipment (for air-conditioning, controls, power, etc.) .57 Earth stations vary considerably in size, from large stations, such as the INTELSAT Standard A stations that send and receive most international trunk communications, which have 30-meter antennas, to receive-only equipment whose antennas are less than 1 meter in diameter. INTELSAT Standard A stations cost $5 million to $9 million each (higher-density INTELSAT C stations can cost up to $15 million), compared to 5-meter and smaller transmit and receive stations that might cost $200,000 to $300,000.[58] Small receive-only stations, such as those used for CATV or home reception, can cost as little as $2,000.[59]

The larger stations are purchased mainly by common carrier communications firms, which carry domestic and international switched voice and message traffic and television. Common carriers also use medium-sized stations in locations with smaller traffic volumes. Specialized data and television carriers and firms operating private communications networks use medium-sized Earth stations located on "customer premises."[60] Receive-only stations on customer premises are typically small and are used only **for television and data reception.** They may be purchased by businesses for point-to-multi-point teleconferencing networks or data transmission (when it can be carried out at slow speeds) and by home consumers for television reception.

Nippon Electric Co. (NEC), a Japanese firm, is the largest manufacturer of large nonmilitary Earth stations, having manufactured approximately one-third of all such stations around the world .61 The cumulative market shares, by country, for major suppliers from various countries for INTELSAT standard A and B stations are shown in table 6-8. Over the whole period, U.S. major firms had the largest share–39 v. 37 percent for Japanese firms–but this larger share of U.S. firms reflects their early dominance. Japanese firms now dominate new orders.

In addition to leading in sales of standard INTELSAT Earth stations, NEC also leads in large and medium-sized domestic-system Earth stations. It sold in excess of 500 Earth stations in 15 countries prior to 1984 and is particularly strong in total equipment technology. [b2]

Despite its worldwide preeminence, up to the present, NEC has rarely been seen as a major competitor in U.S. Earth station sales. Nevertheless, it recently penetrated the U.S. market in a significant way, with the sale of **130** RF terminals (antennas and radio-frequency electronics) to IBM's Satellite Business Systems network. (IBM provided its own digital baseband equipment.)

in Europe, Alcatel-Thompson/Telspace is the largest manufacturer of Earth stations, with approximately 580 systems of all types operating, under installation, or on order. **It** has supplied 30 INTELSAT Standard A terminals plus another 30 Standard B and C stations for international traffic and 21 for domestic leased-capacity traffic. It is also supplying 467 stations for France's Telecom 1 network. Of these, 350 will be the 2.0 to 2.3 meter video receive-only type and 116 will be 3.5 meter business data transmit/receive terminals.

[57] Eloise Jensen, Tracey Harbaugh, **Kenneth** Telesca, **and** James **Mahoney, "Sector Study–Satellite Earth Stations, " The Export-Import Bank, Washington, DC,** June **1984.**

[58] Industry **sources.**

[59] Unpublished **memorandum, Ford Aerospace &** Communications, **1981.**

[60] Chris Bulloch **and Paul Rubin, "Satellite** Telecommunications—**The Ground Segment Grows, "** *Interavia,* **November 1984, pp. 1231-1235.**

b'ibid., p. 1233.

[62] Ibid., p. 1234; Richard Shaffer, ''Japanese **Now Target** Communications **Gear as a Growth Industry, "** *The Wall Street Journal,* **Jan. 13,** *1983,* p. 1.

Table 6-8.-Earth Station Market Shares, By Country of Supplier, For the Period 1965-82

United States (Harris, GTE, ITT, RCA, Page)	39°A
Japan (**NEC,** Mitsubishi)	37°/0
France (Thompson CSF, **Alcatel-Thompson/Telespace)**	**13%**
Italy **(STS)**	**5%**
United Kingdom (Marconi)	4°/0
West Germany **(Siemens)**	**2%**
Canada **(Spar)**	**n/a**

SOURCE: Derived from Eloise Jensen, Tracey Harbaugh, Kenneth Telesca, and James Mahoney, "sector Study—Satellite Earth Stations," The Export-Import Bank, Washington, DC, June 1984.

Although U.S. manufacturers are no longer the dominant suppliers of large Earth stations as they were in the beginning phase of satellite communications, they continue to win contracts for INTELSAT A and B stations and are particularly competitive in specialized, medium-sized Earth stations for domestic satellite systems, which are a growing part of world demand, and in digital subsystems associated with large station networks.[63] This has resulted in U.S. companies such as Scientific Atlanta, Harris, GTE, and M/A Corn increasing their relative share of U.S. exports of Earth stations or associated equipment. ITT_, RCA, and Page have seen their exports decline. California Microwave is an important additional participant in the U.S. domestic Earth station market.

Customer-premises Earth stations include small to medium-sized transmit/receive Earth stations as well as television and data receive-only equipment. Although reliable sales data is not available for sales of customer-premises Earth station equipment, because satellite ground equipment is not broken out of the more inclusive data category for telecommunications equipment as a whole, it appears that, worldwide, most such stations are manufactured by U.S. firms and sold in the United States.[b4] The direction of technological change is toward higher-power, more sophisticated satellites making possible smaller, less expensive, but technically advanced Earth stations that can be used for corporate data transmission and videoconferencing. U.S. firms, represented by Scientific Atlanta, M/A Corn, and numerous smaller firms, are still dominant at this end of the market, and appear to have the technical edge, particularly in equipment for digital transmission.[bs]

Television receive-only Earth stations (TVROS), which are primarily used to feed large or small television cable networks, are already a large part of the total demand for Earth stations in the United States and are becoming so in Europe, where a major proportion of Eutelsat's ECS system capacity is devoted to TV distribution. Whether the market for TVROS will continue to grow will depend on the ultimate popularity of high-power direct broadcasting systems (DBS) designed to feed very small home TVROS. Scientific Atlanta has supplied over 10,000 Ku-band TVRO Earth stations to individual cable systems. The company has also supplied video uplink stations to over 350 U.S. television stations. Harris Corp., another major U.S. supplier of cable TVRO stations, is the contractor for 180 ground stations for NBC television affiliates. DBS receiving dishes, if a mass residential market develops, will undoubtedly be sold through consumer electronics channels. Somewhat larger and more expensive TVRO dishes, capable of tapping directly into existing cable distribution systems, are already being marketed in this way (see app. 66 of this chapter) .[66]

A significant and growing number of medium-size and small Earth stations, ranging from one-way data to full two-way voice and data, are being used in corporate networks and in shared tenant systems operated by office building management firms. These networks, using small send/receive Earth stations, are now very competitive in cost with established local and long-distance telephone companies for two-way voice communication. This has been called the "bypass problem"; the equipment itself is said to embody "bypass technology."

A U.S. firm, Equatorial Communications Co., has been very successful in marketing very small, receive-only dishes, only 2 feet in diameter, that permit reception of computer data at relatively slow speed but at a cost only about 60 percent of AT&T's charges for functionally equivalent private-line service. Major corporations, such as the Associated Press, Reuters, Dow Jones, and E.F. Hutton, concentrated in the media and financial sectors, have collectively purchased 20,000 of these $2,500 one-way dishes in the last 3 years. In 1984, Equatorial began to sell a new line of 4-ft send/receive digital Earth stations for low-speed data transmission.[67]

The most rapid growth in demand for satellite services (primarily domestic), and in ground equipment, will probably occur in the data, tele-

[63]Jensen, et al., op. cit., p. 10.

@private communication, International Association Of Satellite Users and Suppliers, March 1985.

[65]Jensen, et al., op. cit., June 1984.

[66]Bullock and Rubin, op. cit., November 1984, p. 1232.

[67]"Tiny Satellite Dishes Are Serving Up a Hot New Market," *Business Week*, Mar. 11, 1985, pp. 102, 106.

vision distribution, and videoconferencing areas. Business data services are projected to be the largest growing segment of the satellite communications market. Internationally, INTELSAT has developed new E- and F-Standard stations for its INTELSAT Business Service. California Microwave, Fairchild, and GTE are the primary competitors in this field, and Scientific Atlanta has developed an Integrated Business Terminal that is roof-mounted, fully remote controlled, and requires no air-conditioning. Rural thin-route telephony and mobile services, while not a large element in total sales, may require a large number of Earth receiving units.

Competitive Factors in International Earth Station Markets

The competitive factors influencing sales of Earth station equipment are different in the three market segments: 1) INTELSAT and other large standardized Earth stations, 2) medium-sized, "domestic" Earth stations, and 3) television and data receive-only equipment.

In the world market for large Earth stations, where typical contracts are in the $5 million to $15 million range, procurement restrictions and price (including the cost of financing) appear to be the principal competitive factors affecting international market shares. The Japanese, French, German, and Italian markets are essentially closed to U.S. manufacturers of INTELSAT and domestic-satellite Earth stations because of government procurement restrictions. The markets of other European countries, though, are not fully closed. In recent years there have been sales by Japanese companies in the United Kingdom, Sweden, and Turkey. But these markets are not fully open either. The problem is that the buyers of large Earth stations are usually PTTs, which are not covered by the GATT Government Procurement Code, and they typically discriminate in favor of local manufacturers or make other discriminatory purchases. In the case of Japan, even if the telecommunications sector should be opened generally to foreign telecommunications equipment, NEC would probably still dominate the market for large Earth stations for the same reasons of low price and high quality that have led to its current dominance in other world markets outside of Europe.

In the rest of the world–the United States, the smaller industrial countries outside the EEC, and the developing world—price appears to be the principal competitive factor in the sale of large Earth stations. Subsidized financing through the use of mixed credits has been a determining factor in a some sales to developing countries.[68] Other competitive elements in sales to developing countries have been political factors (French-speaking West Africa) and the willingness of suppliers to meet local content thresholds (Brazil).[bg] For large Earth stations, superior technical features appear as a competitive factor only in the digital subsystems. NEC (particularly outside the United States) and U.S. manufacturers like M/A Corn, COMSAT, Comtech, and Fairchild appear to have a competitive advantage in these subsystems.

Technical features are a more important competitive element for medium-size customer premises Earth stations than in large ones, because technical change is faster and customer needs are more differentiated. For this reason, restrictive telecommunications standards join restrictive procurement practices as trade barriers to U.S. exports to Europe and Japan .70 Industry sources in the United States believe that both the Japanese and EEC markets are effectively closed to U.S. manufacturers of customer premises and domestic-system Earth stations at the present time. " Exporting to these markets, however, is likely to be more possible in the future, as businesses in foreign countries increasingly come to use customer premises equipment in corporate information/communications networks and seek to control it through ownership, rather than lease it from

[68] Jensen, et al., op. cit., app. 11. Also Robin Day Glenn, "Financing of United States Exports of Telecommunications Equipment, " International Law Institute, Georgetown University, Washington, DC, 1982, pp. 34-39.

[69] Jensen, et al., op. cit., p. 9.

[70] As a Control Data executive put it, "If you' re trying to bring in a competing product, a written request may gather dust for four years before it's certified by the PIT, " quoted in Gary Stix, "PTTs Make Life Rough Overseas, " *Computer Decisions*, Apr. 9, 1985.

[71] "Europe's Technology Gap, " *The Economist, Nov. 24, 1984*, pp. 93-98. Shaffer, op. cit.; U.S. Department of Commerce International Trade Administration, *Country Market Survey— Telecommunications Equipment: Japan,* CMS/TCE/558/83, April 1983; John Burgess, "Japan's Phone Shake-Up May Profit U.S. Firms," *The Washington Post, Nov. 18,* 1984, p. 51; and "Phone Market: Japan Keeps Hanging Up on the U.S., " *Business Week,* Mar. 11, 1985, p. 67.

the PIT. In the case of Japan, while domestic telecommunications privatization and competition and trade understandings with the United States may succeed in opening up some sectors of Japan's telecommunications market to foreign competition, industry sources are skeptical that it will have measurable impact in the Earth station market.

In any case, by far the largest portion of the world market for customer premises Earth stations is currently in the United States. In this market, dozens of established and new firms compete for the business of corporate networks and shared-tenant systems in office buildings. Because technical change has been rapid in the customer premises segment, the ability to assist customers with technical sales support activities is an important competitive factor in addition to price.

At the low end of the market, the receive-only segment, the world market is again principally concentrated in the United States. When the product sold is simply the equipment, the principal competitive factor is price. When the product is sold as part of a data-transmission service package, however, the price of the equipment has not been the major factor. The large numbers of small receive-only dishes sold (or leased) by Equatorial Communications, for instance, are not in competition with other small Earth stations. Rather as a required component of Equatorial's spread-spectrum service, they compete with terrestrial alternatives such as packet-switching services. price competition may become more intense as new firms enter the market for small-dish satellite data transmission services, however.

One indication that this may happen in the near future is that a significant number of firms are now in bidding competition to provide approximately 50,000 small transmit/receive Earth stations for Federal Express's Zap Mail service. Besides Equatorial, the main contenders are NEC, Mitsubishi/COMSAT, Fujitsu, and Matsushita (in collaboration with Harris and Scientific Atlanta). The bidders on this huge contract ($500 million to $750 million) may be in a position to challenge Equatorial's dominance in other sectors of the market for small data-oriented Earth stations.

COOPERATION AND COMPETITION ISSUES IN INTERNATIONAL SATELLITE COMMUNICATIONS

International Context of Satellite Communications

By its nature, the world satellite communications network is an important arena for international cooperation. The United States participates with other nations in a number of specialized international institutions producing satellite communications services and dealing with the regulation of international telecommunication services. Because of the politics of these organizations, U.S. telecommunications interests are frequently linked to wider foreign policy concerns, and conflict originating in diverse contexts can spill over into telecommunications matters. *

In recent years the reverse process also appears to be occurring. Conflicts originating in the satellite communications area now affect broader U.S. foreign policy interests. These conflicts, in turn, have grown out of two fundamental trends in satellite communications:

1. The expansion of the world's satellite communications industry is producing potential crowding in the geostationary orbit.[72] This has resulted in conflict with developing countries in international organizations.[73]
2. Technology-driven change in satellite networks, data processing, and telecommunica-

*See ch. 3 for an in-depth discussion of issues relating to the U.S. role in international organizations. See also *Unispace '82: A Context for Cooperation and Competition,* op. cit.

[72]See box, p.174 for a description of the use of the geostationary orbit for communication satellites.

[73]Certain industrialized countries, notably Canada, may also have interests that potentially conflict with those of the United States with regard to the geostationary orbit.

tions generally is upsetting the current international regulatory regime and the existing cooperative arrangements in satellite communications.[74] It has resulted in conflict between the United States and other industrial countries.

The expansion of the world's satellite communications industry has made access to the geostationary orbit an issue. It is basically a "North-South" issue between the industrial countries of the "North" and the developing countries of the "South. " The crowding that is currently developing in that portion of the geostationary orbit that serves the Western Hemisphere, mostly for satellites broadcasting in the C band, is the result of the continuing expansion of U.S. domestic satellite systems. A World Administrative Radio Conference of the International Telecommunication Union scheduled to convene in August 1985 will attempt to develop new international mechanisms to deal with the issue.

Prospective moves by the United States to alter the international regulatory regime in satellite communications (discussed above and in app. 6A) constitute a second major satellite communications issue.[75] It is primarily a "North-North" issue between the United States and other industrial countries but has an important "North-South" dimension as well.[76] The general issue is whether the United States should attempt to derive the benefits of the free market in international telecommunications, as it does in most other industries, even if other countries are opposed to competition.

The most contentious specific issue at present is whether the United States should allow the entry of U.S. firms into transatlantic satellite communications in full or partial competition with the International Telecommunications Satellite Organization (INTELSAT). As described below, an initial move was made in this direction in November 1984, when the Reagan Administration found that private satellite systems were "required in the national interest.[77] The decision to allow U.S. firms to launch private satellite communications facilities in competition with INTELSAT has the potential for causing difficulties with other governments that actively seek to limit competition in telecommunications. Beyond the INTELSAT issue, the United States must also face the broader question of how much conflict to allow into the necessarily cooperative regulation of international communications.

A second highly contentious competition issue–the issue of access for U.S. telecommunications equipment manufacturers into other industrial country markets—also arises because the United States wishes to derive the benefits of free markets in telecommunications equipment, both within the United States and in international trade. The open market for telecommunications equipment within the United States has brought into sharp relief the restrictionist policies of other industrial countries toward trade in satellite and other communications equipment.

These conflicts with other countries in international satellite communications can best be understood in the organizational context in which the United States participates with other countries in operating and regulating the international satellite communications system.

U.S. Participation in International Organizations Concerned With Telecommunications

In international satellite communications, the United States interacts with other nations both through bilateral diplomacy and within international institutions. Outside of North America, formal bilateral telecommunications service agreements of any substance between the United States and other governments are rare, but bi-

[74] "International regulatory regime" is defined in note 6 above in this chapter.

[75] For a treatment of how certain aspects of the international regulatory regime affecting frequency allocations evolved, see David M. Leive, *International Telecommunications and International Law: The Regulation of the Radio Spectrum,* Oceana Publications, 1970.

[76] A currently controversial issue within INTELSAT is the concern that less developed countries have about the impact of competition in the North Atlantic on the present global averaging of the INTELSAT unit charge.

[77] Presidential Determination No. 85-2, Nov. 28, 1984. This has been elaborated in Departments of State and Commerce, "A White Paper on New International Satellite Systems, " op. cit.

lateral activity takes place short of formal agreements. In addition to according representation to U.S. commercial interests, the Government is diplomatically active in connection with its participation in the activities and meetings of international organizations.

Such organizations include:

1. International Telecommunication Union (ITU):
   - –Consultative Committee on Radio (CCIR)
   - –Consultative Committee on Telephone and Telegraph (CCITT)
   - —World Administrative Radio Conferences (WARC)
   - –Regional Administrative Radio Conferences (RARC)
   - —International Frequency Registration Board (IFRB)
2. United Nations Committee on the Peaceful Uses of Outer Space (COPUOS)/United Nations General Assembly
3. United Nations Educational, Scientific and Cultural Organization (UNESCO) [United States withdrew at the end of 1984]:
   - –International Program for the Development of Communication (IPDC)
4. Universal Postal Union
5. International Telecommunications Satellite Organization (INTELSAT)
6. International Maritime Satellite Organization (INMARSAT)
7. Organization for Economic Cooperation and Development (OECD):
   - –Committee on Information, Computer, and Communications Policy (ICCP)
8. North Atlantic Consultative Process (NACP):[78]
   - –European Conference for Post and Telecommunications (CEPT)
9. Organization of American States (OAS):
   - –La Conferencia Interamericana de Telecomunicaciones (CITEL)

The ITU and Other Specialized United Nations Agencies

The first four organizations in the above list are within the United Nations group of organizations and, if voting takes place, operate within the rules of one-nation-one-vote typical of such organizations. They perform the international regulatory functions of setting the legal framework for the use of space, setting telecommunications standards, allocating radio frequencies, and allotting positions in the geostationary orbit. The dominant politics of such organizations is the general politics of "North-South" relations between the industrialized and the developing nations.

Superimposed on the North-South politics are the East-West politics of Soviet-U. S. confrontation and the "North-North" alliance-cum-competition politics of the industrial countries.[79] When substantive regulatory decisions are taken in regular or special meetings of the ITU or other specialized U.N. bodies, the general practice of the past has been to develop as much consensus as possible on conventions to be submitted to governments for ratification.[80]

At ITU meetings, many votes are taken, but to preserve the consensus on basic issues, delegates usually agree to reschedule unresolved major issues for later resolution. Certain significant issues dealing with the allotment of the geostationary orbit, for instance, were not dealt with at the 1979 World Administrative Radio Conference (WARC) of the ITU because of their controversiality. instead, the issues were put off for future consideration.[81] After limited discussion at WARC '79,

78 While not a formal organization', the North Atlantic Consultative Process is an organized effort involving the European PTTs, U.S. International Service Carriers, the Federal Communications Commission and other U.S. and foreign governmental entities in ongoing facilities planning activities. There is an even more informal Pacific Planning Process.

79 Within the industrialized country group, the CEPT countries often constitute a European regional bloc in telecommunications matters.

80 In COPUOS, consensus operation is taken to the extreme in that voting, even unanimous voting, is not a practice. Unresolved issues either stay unresolved or are passed on to the Special Political Committee and the General Assembly. This does not always guarantee a lack of contentiousness; the United States in 1984, for instance, walked out of a COPUOS debate on the militarization of space on the grounds that it was the wrong forum and the U.S. delegate indicated that it was considering quitting the committee over the issue (*Washington Post,* June 15, 1984, p. A28).

81 The issue of planning the geostationary orbit was also aired at the UN ISPACE '82 conference, without being resolved. (*Unispace '82: A Context for Cooperation and Competition,* op. cit.)

where the contentiousness of the issues became apparent, the delegates decided to schedule a special WARC to consider them (see below).

In recent years, a trend toward the politicization of the specialized United Nations agencies, including those that deal with international satellite communications, has emerged to threaten the consensus mode of operation, For instance, at the ITU plenipotentiary in Nairobi in 1982, after a maximum worldwide diplomatic effort by the United States and its allies and an explicit U.S. threat to withdraw from the ITU, a key procedural question bearing on the attempted expulsion of Israel nevertheless almost attracted a majority and failed by a scant four votes. [82] In UNESCO, another forum in which telecommunications issues are discussed, politicization was one issue cited by the United States when it withdrew at the end of 1984,[83]

Both the politicization of international for a and the countervailing threats of the United States to withdraw threaten the cooperative operation of international organizations, including the ITU and other organizations dealing with satellite communications. In addition to this general politicization and the U.S. reaction to it, certain factions composed of developing countries may be increasingly willing to violate the consensus-building mode of operation strictly on telecommunications issues. For **both these reasons, the United States may, therefore, face difficult decisions** in the coming decade if it should find itself on the losing side in votes taken on contentious telecommunications issues.

The basic calculation implicit in U.S. participation is whether the net benefits are positive (when all the linkages with other issues and negotiations are considered). Economic costs-higher than necessary communications costs for U.S. residents and less of an array of services—may result from the regulatory arrangements of an achievable consensus. But there may also be the economic benefits of continued orderly communications that could not otherwise be ensured.

Looked at from another angle, the United States might have to shoulder significant political costs in order to persuade reluctant delegates to adhere to a consensus that benefits the United States. Thus, there could be significant costs to a policy of building and adhering to consensus within the ITU and other international organizations. On the other hand, confrontation in these for a, or withdrawal from them, could also have large economic and political costs.

Effectively balancing these costs has been a difficult assignment for the diffuse and frequently ad hoc U.S. policymaking apparatus in international telecommunications. on the one hand, policy makers must have effective knowledge about the telecommunications and space sectors and the importance of substantive matters. On the other, they must also have knowledge of the full international economic context of the United States, the connections of telecommunications negotiations to this context, and the diplomatic costs of accommodation or confrontation. U.S. diplomacy, however, has often not been informed by all these requisite skills.[84]

Regional Organizations or Suborganizations in the Americas Dealing With Satellite Communications

Two entities deal solely with Western Hemisphere communications matters: CITEL (affiliated with the Organization of American States) and the ITU Region 2 Regional Administrative Radio Conferences, which are held periodically. Given their framework of one-nation-one-vote, they exhibit similar characteristics to those of the full ITU and other international for a that are similarly organized.

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[82] As of December 1984, the ITU had 158 members (source: U.S. State Department, Office of International Communications Policy).

[83] For a discussion of various U.S. and foreign points Of view on the withdrawal see "World Forum: the U.S. decision to withdraw from UN ESCO," *Journal of Communication*, vol. 34, autumn 1984, pp. 81-1 79; and Lois McHugh, U.S. Withdrawal From the International Labor Organization: Successful Precedent for UNESCO?" Congressional Research Service Report No. 84-202, Nov. 8, 1984.

[84] See U.S. Congress, Office of Technology Assessment, *Radiofrequency Use and Management: Impacts From the World Administrative Radio Conference of 1979* (Washington, DC: U.S. Government Printing Office, January 1982); and *UN/SPACE '82: A Context for International Cooperation and Competition,* op. cit. See also Simon Jenkins, "A Diplomat Now Needs Expertise Rather Than Experience, " *Listener, vol.* 111, Mar. 22, 1984, pp. 2-4 for a discussion of the diplomacy needed in modern foreign relations.

Weighted Voting Institutions

Two international institutions in the satellite communications area—INTELSAT and INMARSAT[85]—are controlled through a process of weighted voting and hence exhibit different institutional characteristics from the U.N. or regional organ izations.[86]

While INTELSAT is an operating organization that provides almost all of the world's international satellite communications capacity, it can also be viewed as an intergovernmental organization whose board of governors establishes policies affecting the two-thirds of intercontinental communications that pass through its transponders. In this limited sense, INTELSAT is one of the key elements in the regulation of international communications. In INTELSAT'S board of governors, a country's voting power is determined by its volume of communications on the INTELSAT system. Because they are the big users, a small coalition of the United States and a few industrial countries can muster a majority of votes (see table 6-5, above, and app. 6C of this chapter). Nevertheless, non-unanimous votes are rare. Consensus is still the norm in INTELSAT. The consensuses the United States adheres to in INTELSAT, however, are influenced by its juridical voting power and not just by its diplomatic efforts.

It would therefore be expected that North-South issues would be muted in INTELSAT, and this is usually the case. For this reason and because they must manage INTELSAT as a functioning commercial entity, developing-country members have incentives to keep politicization to a minimum. Nevertheless, because INTELSAT is increasingly likely to be a locus of "North-North" deregulatory and trade controversies among the industrial countries, and because developing countries may be receiving benefits from cross subsidization (through a process called "global averaging"),[87] the future of INTELSAT is likely to become a North-North and North-South question at the same time.

INMARSAT, a second international satellite organization, which was established in 1976 and commenced service in 1982, aims to increase the efficiency and safety of marine transportation by providing effective communications.[88] Unlike INTELSAT, INMARSAT does not currently own its own satellites; instead, it leases or is committed to lease capacity from MARISAT (a joint venture of U.S. communications carriers), ESA and INTELSAT.[89] To date, it has not been an important arena for international controversy, except for subtle jockeying among the major industrialized-country members for shares in procurement, but East-West and North-South politics could become more important in INMARSAT in the future. Politicization of the organization along the lines of the U.N. Specialized Agencies, is unlikely,

[85] In the Communications Satellite Act of 1%2, Congress set basic goals for international satellite communications and of U.S. participation in it. COMSAT, a private corporation, was subsequently chartered and designated to represent the United States in INTELSAT and INMARSAT. Most countries are represented in INTELSAT by their post, telephone, and telegraph (PTT) administrations.

[86] The reality of INTELSAT's operation has been that of a weighted voting institution, but the actual legal structure of the organization is somewhat complicated. The 1973 INTELSAT Agreement provides for two one-nation-one-vote bodies formally superior to the weighted-voting Board of Governors. These are the Assembly of Parties (governments), which usually meets every two years, and the Meeting of Signatories (telecommunications entities), which meets every year. With a few exceptions, the powers of these bodies are not clearly specified in the INTELSAT Definitive Agreements. See Richard R. Colino, "The INTELSAT Definitive Arrangements: Ushering in a New Era in Satellite Telecommunications," European Broadcasting Union, Geneva, 1973. Both bodies were characterized in one critical review of INTELSAT (Michael E. Kinsley, *Outer Space and Inner Sanctums (New* York: Wiley, 1976), p. 128) as "impotent. " Nevertheless, the INTELSAT 1982 Annual Report indicates that the Meeting of Signatories "accepted the recommendation of the Board of Governors to increase INTELSAT's capital, " a rather important function, if the ability to "not accept" would have any substantive effect. The Assembly of Parties specifically has the formal power of decision in the INTELSAT procedure of coordinating with separate satellite systems, a power that has recently taken on importance. It may be that, in future years, the character of INTELSAT could take on more of the characteristics of one-nation-one-vote organizations, if the Assembly of Parties or the Meeting of Signatories become more influential.

[87] See, e.g., Testimony of Richard R. Colino, Hearings Before the Subcommittee on Arms Control, Oceans, International Operations, and Environment, Senate Foreign Relations, 98th Cong., Oct. 19 and 31, 1983, p. 152.

[88] As of early 1985, INMARSAT had 43 members (see app. 6C of this chapter for a list of the members and their voting shares). The INMARSAT Council, modeled on the INTELSAT Board of Governors, is made up of the largest 18 shareholders plus four additional country representatives to insure geographical balance. Voting is weighted according to ownership shares, except that no country can have a weight greater than 25 percent. The ownership shares of the six largest country owners were as follows: United States (30.9 percent), United Kingdom (14.6 percent), Norway (1 1.6 percent), Japan (7.0 percent), USSR (6.9 percent), and Canada (3.9 percent) [source: COMSAT]. COMSAT represents the United States in INMARSAT, as well as in INTELSAT.

[89] David W. Lipke, "IN NMARSAT Plans for New Satellites, " *Marifacts,* March 1983.

however, because the major maritime countries are also the major actors, as a result of its weighted voting mode of governance (see app. 6C). The commercial goals of the organization also militate against politicization.

Nevertheless, the presence of the Soviet Union within the organization has resulted in technology transfer controversy with the U.S. Government. COMSAT, which holds the management contract for INMARSAT, was prevented by the U.S. Government (through delay of an export license) from providing the results of several small study contracts to other members of INMARSAT.[90]

In March 1985, it was reported that INTELSAT and the U.S.S.R. might sign an information exchange agreement.[91] Although it would be premature to assume that such an agreement would lead to U.S.S.R. membership in INTELSAT, such membership might intensify U.S. concern about issues of technology transfer. The People's Republic of China is already a member, as are Vietnam and Afghanistan.

Industrial Country Organizations

In addition to INTELSAT and INMARSAT, the United States participates in two other organized groups that are ordinarily concerned with international telecommunications between the industrial countries, the Organization for Economic Cooperation and Development (OECD) and the North Atlantic Consultative Process (NACP).

The OECD[92] provides a setting where industrial countries can reach understandings on satellite communications (as well as many other) issues and also can develop coordinated positions on North-South issues. A special arrangement concerned with the terms of export finance in satellite ground segment equipment, for instance, has been reached under the aegis of the OECD. In the NACP (in coordination with similar planning within INTELSAT), an ad hoc group of representatives of U.S. and European governments and/or their communications carriers discuss communications facilities planning for transatlantic communications. While not a formal organization, per se, because it has no charter or secretariat, the NACP and its working groups (NACPWG) constitute one of the most important elements in the international regulatory regime[93] affecting U.S. international communications.

U.S.-Europe controversy over liberalization in international communications has recently increased as the newly deregulated long-distance communications industry in the United States has attempted to deal with the European industry, with its general preference for restrictions on entry and trade in both international telecommunications services and equipment. It finds a locus in INTELSAT, INMARSAT, OECD and the NACP, as well as in relations between carriers and governments. There is a good possibility that differences among the industrial countries over how to structure international telecommunications will make it difficult for the North to take a unified position in some North-South disputes, and it may result in a position of isolation for the United States on certain telecommunications issues in international organizations and meetings.

Space WARC and the Issue of the Allotment of the Geostationary Orbit

"Space WARC," whose first session "ORB-85" will convene in August 1985, is one of the ITU World Administrative Radio Conferences that regulate international satellite communications. ORB-85 will attempt to resolve the issue of equitable access for all countries to the geostationary orbit by devising mutually acceptable changes in the arrangements by which radio frequencies and orbital locations are assigned. Three years later, the second session–ORB-88–is designed as a follow-on and implementing conference and will provide an opportunity to fine-tune decisions reached at ORB-85.[94]

'Conversations with industry sources in 1983. See below, p. 192.

[91] "U.S.S.R, May Join INTELSAT Consortium Within 2 Yearsr" *Washington Post,* Mar. 13, 1985, p. 1; "Fingerprints on the Self-Destruct Button, " *Chronicle of International Communication,* March 1985, p. 1.

[92] Membership includes the United States, Canada, Japan, Australia, New Zealand, and the governments of all European industrial market economies.

gl"International Regulatory Regime" is defined in note 30 above in this chapter.

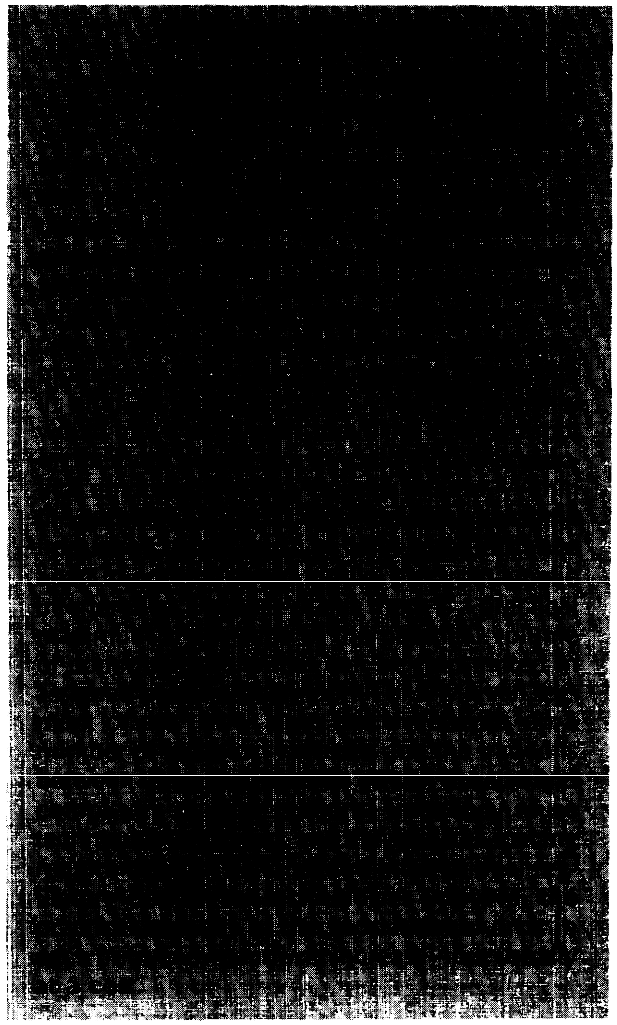
[94] See A. M. Rutkowski, "The Space WARC," *Telecommunications,* January 1984 and "Space WARC Momentum Builds," *Chronicle of International Communication,* October 1984, vol. 5, No. 8.

The conference is being taken seriously by the U.S. Government.[95] The United States not only has important specific satellite communications interests relating to the geostationary orbit, but, since ITU decisions on how frequencies are allocated affect the full range of U.S. civilian and military communications, the United States also has an important general interest in the successful operation of the conference and of the ITU generally. Alternatives to even a poorly functioning ITU all have serious disadvantages from the U.S. point of view.[96]

Potential Western Hemisphere Crowding Important to U.S. Satellite Communications Operators

In the geostationary arc above the Western Hemisphere, the problem of actual scarcity may arise at the end of this decade, depending principally on the demand for U.S. domestic satellite communications. In the preferred C and Ku bands, many of the most desirable slots for U.S. communications satellites are already taken. As of January 1984, there were 44 satellites in orbit or assigned orbital locations by the Federal Communications Commission for launch prior to 1988.[97]

There may come a time in the not too distant future, depending on how rapidly U.S. domestic satellite communications expands, when close substitutes for desired C (6/4 GHz) and Ku (14/12 GHz) band slots will not be obtainable unless a satellite currently in orbit is deactivated. A study done recently for NASA by Western Union Telegraph Co. concluded that crowding in the C and Ku bands will be such that slots in the higher frequency Ka band (30/20 GHz) will be needed for U.S. domestic communications starting in the early 1990s.[98] The conclusions were based on rapidly expanding demand for domestic satellite communications. If it does not materialize, the



crowning would be less or, with low demand, might not occur at all.

The issue for the United States at Space WARC is that crowding in the C and Ku bands would occur sooner under an institutional arrangement favored by many less developed countries in and out of the Americas. In various versions this would essentially assign future rights to the geostationary orbit to individual countries, utilizing an a priori planning process to do so. The availability of geostationary arc locations for the United States for C and Ku band transmission could be reduced, under such a scheme, because particular slots would be reserved prior to use and might

[95] See, e.g., FCC First Report and Order in the matter of ORB-85], FCC 85-94, released Mar. 1, 1985.

[96] For ational discussion of policy options regarding U.S. participation in the ITU, see ibid. and Leslie Milk and Allen Weinstein, "United States Participation in the International Telecommunication Union: A Study of Policy Alternatives, " paper prepared for the Department of State as part of its external research program, undated.

[97] FCC, "United States Domestic Satellite Summary, " unpublished table, Jan. 11, 1984.

[98] Western Union Telegraph Co., Government Systems Division, "Satellite Provided Fixed Communications Services: A Forecast of Potential Domestic Demand Through the Year 2000," Final Report-Executive Summary, NASA Contractor Report 168145, August 1983, p. 4-1. Ka band (30/20 GHz) commercial satellites are not yet in service in the United States, although several are proposed for launch in the late 1980s. Because of its size and current nonutilization, the possibility of crowding in the Ka band is distant.

be unused for lengthy periods of time.[99]nder the current system of registration and coordination, slots are not reserved but are made available on a first-come-first-served basis.

It is, of course, possible that under an a priori scheme slots could be made available to U.S. satellite operators by the countries to which they were allotted, on a rental basis or under an arrangement whereby capacity on U.S. satellites was exchanged for the right to use the slots, These arrangements, even if they could be made, would undoubtedly have direct financial costs and also indirect costs whenever the arrangements resulted in decreased flexibility.

Thus, whether reserved slots would be made available to U.S. satellite operators under rental or other arrangements or not, the economic issue for the United States in Space WARC is still the possibility of both an increase in the cost and a reduction in the effectiveness of its use of the geostationary orbit in the C and Ku bands.

A somewhat different consideration is that if some a priori arrangement did come into force in the 1990s for the C and Ku bands, the United States would have a stake in trying to assure that the ground equipment associated with retired satellites would not be made artificially obsolete. This could happen if no appropriate slots would be assigned for replacement satellites to utilize it. Under current ITU [International Frequency Registration Board] rules, the problem would not arise in most circumstances, since a replacement satellite with the same technical characteristics as a defunct one can be placed in the same slot without a need to go through the complete IFRB registration process.

Access to the Lower Frequency Satellite Transmission Bands Important to Developing Countries

The United States argued at the UNISPACE '82 conference that technological advances that allow more intensive use of the geostationary orbit for C and Ku band transmissions, such as frequency reuse, better station keeping, shaped beams, scanning spot beams, superior ground equipment, and closer spacing are likely to put off the day of scarcity in these bands for the foreseeable future.[100] (This is contradicted by the Western Union study, which states that such scarcity may arrive in the early 1990s.) Furthermore, the United States has argued, the availability of the very high capacity Ka band (30/20 GHz) for satellite transmission reduces the importance of potential crowding in the lower frequency bands. When scarcity does arrive for the C and Ku bands, satellite communications can begin to be transmitted in the higher frequencies of the Ka band.

Representatives from developing countries have pointed out, however, that satellite systems transmitting in the lower frequency C and Ku bands are less costly at given satellite power levels and less technically demanding than satellite systems transmitting and receiving at higher frequencies. The space segment technology for transmission in these bands (particularly the C band technology) is now widely known and ground stations to receive this transmission are less costly than those designed for receiving transmissions at higher frequencies. As such they are more suitable for the rural and remote area communications that are thought to be an important satellite communications contribution to rural development in developing countries.

Developing country representatives have also stated that the present first-come-first-served system allows the industrial countries to exploit a scarce global resource that is the "common heritage of mankind" and, this being the case, developing countries should also benefit from the common heritage by using it or profiting from its use.[101] They fear that if first-come-first-served assignment of orbital slots continues in the C and Ku bands, the industrial countries will have made

[99]Such an a priori allotment scheme was actually incorporated in the 1977 Broadcasting-Satellite Plan for ITU Regions 1 and 3. It arbitrarily allotted a minimum of four or five transmission links to every country irrespective of any requirements (FCC, op. cit., Mar. 1, 1985, p. 43, note 127).

[100]See *Unispace '82: A Context for International Cooperation and Competition,* op. cit.

[101]Taking a different approach, certain equatorial countries have claimed (without much international support) that the geostationary orbit above their territories is within their national jurisdictions. In 1976, seven equatorial states, including Colombia, Ecuador, and Indonesia signed the Bogota Declaration claiming sovereignty over portions of the geostationary arc.

substantial further investments in ground equipment appropriate to those bands. The existence of this investment will then constitute an argument for renewing the supposedly temporary assignments, and the developing countries will have lost out permanently.[102] The developing-country proposals for a system of a priori allotment of orbital slots are based on these ideas of common heritage and equitable access.

A Priori Planning Would Tend to Increase Crowding in the Geostationary Orbit

The United States has an important stake in Space WARC. Any a priori planning system to assign the remaining orbital slots in these bands (plus previously occupied slots that become vacant) would tend to increase the crowding already experienced by U.S. communications carriers in the C and Ku bands, if it should place a significant number of slots out of their reach. (It should be noted that any allotment scheme decided on by ORB-85 and implemented in detail in ORB-88 would not take affect until 1989 at the earliest.) By then almost all of the slots above the Western Hemisphere that are desirable for U.S. domestic communications may well have already been occupied (mainly by U.S. domestic satellites).

If both U.S. launch schedules and the Space WARC schedule are maintained, the question of greatest economic importance to the United States would seem to be whether slots then occupied by U.S. satellites would be reassigned to other countries when U.S. satellites are decommissioned. Other countries will, of course, be aware of the possibility that U.S. satellites may occupy most of the desirable slots before a planning scheme could go into effect under the present conference timetable. Their ORB-85 positions may, therefore, include proposals for early implementation of any planning scheme adopted and rigid safeguards to stop first-come-first-served occupation of geostationary slots by U.S. satellites in the late 1980s.

[102]This argument, in fact, is made explicitly in an FCC ORB-85 preparatory document (FCC, op. cit., Mar. 1, 1985, app. B, p. 8).

Close Substitutes to C and Ku Band Satellite Transmission Set Limits on the Economic Cost of Crowding

Fortuitously, at the same time that potential crowding in the geostationary orbit has appeared, it has also become apparent that that the United States can expect to have two important close substitutes for satellite capacity in the C and Ku bands in the 1990s:

1. satellites transmitting in the large Ka band (30/20 GHz), which, however, requires more sophisticated satellites and ground-segment equipment; [103] and
2. the developing domestic and international fiber optic cable network.[104]

The existence of these two substitutes clearly limits the potential economic damage to the United States of losing C and Ku band capacity. Ka band capacity, which has yet to be fully developed, will probably be somewhat more costly than that in the C and Ku bands, since, for many applications, more sophisticated satellites and Earth stations will be required to avoid significant effects from the rain attenuation of satellite signals. For certain high-volume uses, there is a possibility that Ka band technology, when it has been developed sufficiently, may be more cost effective than C or Ku band technology, or that the penalty will be very slight, but there seems to be general agreement that there will be some cost penalty in most cases for U.S. carriers to substitute Ka band transmission for that **in the C and Ku bands.**

There also is general agreement that the emerging fiber optic domestic and international cable networks will be fully competitive with satellites using C and Ku band technology and may in fact be technologically preferred (see discussion above and in app. 6A). A relative shift toward fi-

[103]See the discussion below in this chapter of the NASA ACTS program.

[104]While terrestrial networks are a close substitute for satellites for point-to-point communications, and technically could distribute point-to-m ultipoint communications, they would generally not be used for the latter, unless there were excess network capacity, because of the long-run cost advantage satellites have for point-to-multi-point applications.

ber optic cable transmission for new domestic and international telecommunications capacity is expected to take place in any case. Less availability of C and Ku band capacity might simply make this shift take place sooner or take place to a greater extent than otherwise. Furthermore, because of fiber optic efficiencies, there may not be a cost or service penalty for the shift. Again, this is uncertain, because fiber optic technology is still evolving too rapidly to allow reliable cost projections for the period beyond 1990, when any arrangements determined in Space WARC would come into force.

It should be emphasized that the need for substitutes for C and Ku band capacity and any cost to the United States of using them would only occur if serious crowding, in fact, did materialize in the two bands. Crowding might not materialize if there were a major shift toward fiber optic and other terrestrial transmission modes for the types of U.S. domestic communications now carried by satellite and if earlier projections of direct broadcasting demand prove high.[105]

Foreign Policy Linkage

On the other side of the ledger, the foreign policy cost that the United States would have to pay for an isolated, combative stance at Space WARC against a priori planning of the geostationary orbit must also be considered. Just as the U.S. influence in any Space WARC consensus will depend on the wider influence that it exercises in North-South politics, so will a break in consensus politics of Space WARC affect the ability of the United States to further its general foreign policy objectives.[106]

The U.S. stance at Space WARC also involves a link with U.S. national defense communications requirements. Any breakdown in the current international arrangement on frequency assignments or orbital slots might bring into question the availability of frequencies for military communications. Consequently, there is understandable concern in the U.S. military establishment about anything that might upset the international consensus on arrangements for frequency use.

The problem facing the U.S. delegation and the Administration behind it will be to weigh the various aspects of this issue against each other. The Congress, in its oversight capacity and also because (in the Senate) it will have to decide whether or not to ratify any WARC agreement the United States has signed, will also have to weigh the consequences of various courses of action in Space WARC.

Assistance to Developing Countries

The issues involved in assistance to developing countries in the area of satellite communications are complex and intertwined with general development assistance issues. Should the United States use international institutions, such as INTELSAT, the ITU, and the World Bank, as mechanisms for development assistance or would bilateral U.S. Agency for International Development (AID) programs be more effective in achieving U.S. objectives? Should Congress direct more U.S. development-assistance resources into telecommunications or leave such decisions to AID and other agencies?

Assistance Through INTELSAT'S Operations

The Communications Satellite Act of 1962 directed:

> . . . care and attention . . . toward providing [satellite communications] services to economically less developed countries and areas as well as those more highly developed . . .[107]

The INTELSAT Agreement speaks of extending services to all peoples and to all areas of the world, and INTELSAT has brought many cities in the developing nations into the global satellite network.[108] Developing countries with INTELSAT

[105] Direct broadcasting ventures have been holding back because of competition from cable television and video cassettes, and the part of the spectrum reserved for this use maybe available for other uses. See "FCC Asked to Delay Radio Spectrum Shift," *Washington Post*, Apr. 9, 1985, p. D3.

[106] One close-by linkage that may play a role in the outCOme of the Space WARC sessions is the linkage with INTELSAT politics. One study suggests a U.S. negotiating strategy that would utilize that linkage. See Wilson P. Dizard, "Space WARC and the Role of International Satellite Networks, " Georgetown University Center for Strategic and International Studies, Washington, DC, August 1984.

[107] Communications Satellite Act of 1962, Sec. 102(b).

[108] See Preamble to the Agreement, app. 6D of this chapter.

Earth stations now no longer need to pay extra tariffs to route their international communications to other developing countries through cable systems that pass through the industrialized countries. They also have the opportunity to lease spare INTELSAT capacity for domestic communications when terrestrial communications or satellite ownership are impractical.[109]

While the INTELSAT network has brought modern communications to major cities in the developing world, it has not met the needs of dispersed populations in rural areas or island territories, for example, in the pacific, where small populations live in widely dispersed settlements in a dozen sovereign nations and territories. INTELSAT Earth stations of current design are too expensive for use in these contexts. Such expensive Earth stations are required because transponders of higher power than INTELSAT has deployed on its satellites are necessary to make possible small, inexpensive ground terminals to handle one or two telephone channels.

The current smallest Earth terminals for INTELSAT connection are expensive: the type (Std B) installed in Micronesia in 1982 cost $1.6 million. In an effort to make satellite communications more widely available, the INTELSAT Board of Governors approved in 1983a new (Std D) class of small terminal for isolated areas. In one estimate, this terminal alone will still cost about $60,000 initially. [110]Even with significant cost reductions when mass-produced, Earth station costs of this magnitude, together with the cost of site preparation and other associated terrestrial facilities, would continue to put satellite communications via INTELSAT satellites out of the reach of most developing-country villages and towns.[111]Because of this, INTELSAT, in collaboration with other organizations, has proposed a 16-month satellite test and demonstration program to experiment with health and education programs for populations in remote areas. INTELSAT would provide technical advice and free satellite transmission time using spare capacity.[112]

Assistance Through the ITU

The International Telecommunication Union (ITU) is considering forming a Center for Telecommunications Development to assist developing countries. Such a center has been proposed in the report of the Independent Commission for Worldwide Telecommunications Development (informally known as the Maitland Commission), which has been financially supported by the United States, other governments, and U.S. private firms. ' The center would offer both general advice and analysis on telecommunications development and assistance in detailed project planning with the aim of "bringing all mankind within easy reach of a telephone by the early part of next century.'" [114]

While not opposing multilateral communications programs in general (e.g. World Communications Year '83 and the Maitland Commission itself), the Reagan Administration has opposed channeling U.S. Government development assistance funds to any significant extent through such programs. ' [115]Thus, it is not expected to budget more than minimal funding for the Center and certainly does not favor funding it through a tax on international telecommunications traffic.

[109]INTELSAT also provides capacity for a number of developing countries' domestic satellite systems. As of 1983, some 30 developing or newly industrialized countries were leasing (or planning to lease by 1986) space segment capacity from INTELSAT. (J. N. Pelton, "INTELSAT: Making the Future Happen, " *Space Communications and Broadcasting,* vol. 1, No. 1, April 1983.)

[110]*Aviation Week and Space Technology,* Jan. 16, 1984, P. 203.

[111]In any case, INTELSAT's new low-density services will be useful in certain commercial applications. For instance, a low-density INTELSAT Vista system, also using Std D-1 5-meter antennas, will be used by a U.S. multinational oil company for communication with its drill sites starting in 1985 (Thomas A. McIntyre and Robert H. Emberley, "The Vista Link From Madagascar to Houston, " *Telecommunications,* April 1985, pp. 66g-66q).

[112]*Satellite News,* Aug. 20, 1984.

[113]Independent Commission for World Wide Telecommunications Development, "The Missing Link, " International Telecommunication Union, December 1984. See also *Chronic/e of International Communications,* August 1984, pp. 1-2, September 1984, pp. 1-3, and December 1984, p. 5.

[114]Independent Commission for World Wide Telecommunications Development, op. cit., p. 5.

"5"Cancelled Ticket to Arusha," *Chronic/e of International Communication,* March 1985, p. 1.

Assistance Through Multilateral Lending Institutions

Developing countries spend approximately $8 billion per year on public telecommunications plant (1983 figure cited in the Maitland Report[116]). Most of the external finance for this expenditure comes from commercial sources, augmented by officially supported export credit from exporter countries. Only about $200 million per annum comes from the World Bank; other regional lending institutions, such as the Inter-American Development Bank or the Asian Development Bank, are also not active in financing telecommunications projects. '[117]

Using U.S. influence to encourage international lending institutions to give more emphasis to telecommunications lending is a multilateral akernative to the proposed ITU center. Particularly in the case of the World Bank, it would have the advantage of keeping telecommunications lending in the context of the Bank's ongoing country development assistance programs.[118] It would also make use of its project analysis capabilities, its influential status with both developing country governments and industrial country lenders, and its relative freedom from politicization,

Bilateral Assistance

How to help bring the benefits of satellite communications technology to more people in developing nations is also a policy issue for U.S. bilateral assistance programs.[119]

In the 1970s, the United States used its Applications Technology Satellite series (particularly the highly capable ATS-6) and other programs to demonstrate some of the applications of communications satellites in health, education, and agriculture. After year-long experiments in the United States (Health, Education, Telecommunications Experiments) and in India (the Joint U.S.-India Experiment in Educational Broadcasting), the ATS-6 was used in a 3-month project (AIDSAT) by NASA and AID to show a number of other countries (27, in all) what was possible. The United States and Canada later cooperated in the Ku-band Communications Technology Satellite program to demonstrate applications in education, health, and specialized community services. These programs were phased out beginning in 1973 after the Nixon Administration decided that the Federal Government would no longer undertake advanced technology development for communications satellites or satellite demonstration programs. Some funding for Earth station demonstration projects continues.[120]

In 1982, the United States established the U.S. Telecommunications Training Institute (USJTI) to train developing country nationals in basic and advanced telecommunications technologies and management. USTTI is a nonprofit independent corporation administered by a board of directors representing both industry and govern merit.'[121] Expenses of the training program, including travel and living expenses, are shared among the Government and the telecommunications companies on whose premises the training takes place. * The program is supported by such corporations as AT&T, IBM, GTE, Western Union, MCI, and COMSAT. Some 400 people from 65 developing countries were trained in 1983 and 1984, the first 2 years of operation. As a result of the program, graduates will be better informed about U.S. telecommunications products, and some may be in a position to influence procurement decisions. '[122]

116Independent Commission for World Wide Telecommunications Development, op. cit., p. 57.

117Ibid., app, VII, p. 121.

118See Robert J. Saunders, Jeremy J. Warford, and Bjorn Wellenius, *Telecommunications and Economic Development,* World Bank Publication, Johns Hopkins Press, Baltimore, 1983 for an examination of the issues involved in World Bank lending for telecommunications.

119A discussion of these benefits can be found in ibid. and in "Development Communications," Policy Determination PD 10, U.S. Agency for International Development, Feb. 17, 1984.

120U.S. *development assistance efforts* in telecommunications in fiscal years 1983 and 1984 were estimated by the Academy of Educational Development to exceed $422 million in loans and grants. These efforts, in addition to financing the purchase of U.S.-produced equipment, trained 1,153 LDC participants, arranged at least 63 distinct technical assistance and training programs, and served over 100 countries. Twenty-five U.S. agencies had such activities, but only the Export-import Bank, Overseas Private Investment Corp., Agency for International Development, and U.S. Information Agency made monetary estimates and these are included in the total. (*Chronicle of International Communication,* September 1984, p. 7).

121U.S. Telecommunications Training Institute, *Course Catalog,* 1983-84.

*Travel and living expenses of participants are financed by a variety of sources, including AID, international institutions, and private firms. Participants from some high-income oil exporting countries receive support from sources in their own countries.

122The president's Task Force on International private Enterprise, *Report to the President,* December 1984, p. 114.

The program is, in part, a response to telecommunications training programs conducted by training centers in France and Japan, which also combine development assistance with export promotion.[123]

While AID anticipates substantial increase in support for communications activities, aside from the USTTI program and limited investment in communications infrastructure, it "does not expect to support communications as a distinct program sector."[124] It plans to focus its spending on specific cost-effective communications applications on a bilateral basis within projects in its principal development sectors, agriculture, education, health, nutrition, and population.

With respect to developing country investment in communications infrastructure, AID plans primarily to concentrate on providing technical assistance and training that will help countries: 1) assess their technology needs both for specific sectors or functions and for entire communications systems; 2) plan for infrastructure expansion; and 3) develop operational and maintenance skills for existing as well as new infrastructure, rather than to provide support for the acquisition of such equipment as telephone switching systems, radio or television broadcasting facilities, or communications satellites and ground stations. It takes this position because "other financing mechanisms (both conventional and confessional) exist for communications infrastructure." The door is not closed to "add-ens" of specialized equipment, such as satellite ground stations, though, which would extend the country's communications systems in ways that would accomplish development objectives.

AID also does not intend to finance substantial multilateral development activities in communications and will avoid financing host country participation fees or membership contributions in international organizations or regional/international communications infrastructure.

International Trade in Telecommunications Services

The principal issues in the regulation of international satellite communications services involve how much competition the United States should seek and how aggressively it is prepared to seek it. Despite important deregulatory moves affecting the international arena, which have mostly been offshoots of deregulatory actions in the newly competitive domestic market, the FCC and the Reagan Administration have been rather cautious in extending deregulation directly into international communications. For the most part, the foundations of the international communications regime described above and in app. 6A, in which competition is severely limited, have hardly been touched. As this discussion and that in app. 6A indicate, however, harbingers of change are appearing in virtually every aspect of international satellite communications, as technological and market forces begin to chip away at aging regulatory structures.

Competition for INTELSAT

Competition for INTELSAT is a partial exception to this generalization. Currently INTELSAT has a near monopoly on intercontinental satellite communications facilities, and the recent executive branch decision to sponsor the entry of private U.S. satellite systems in competition with it is a purely international regulatory decision that did not grow out of domestic deregulation.

In the Preamble of the INTELSAT Agreement the contracting parties state that in establishing INTELSAT their intention was:

> . . . to continue the development of this telecommunications satellite system with the aim of achieving a single global commercial telecommunications satellite system as part of an improved global telecommunications network which will provide expanded telecommunications services to all areas of the world and which will contribute to world peace and understanding . . .[125]

[123] Eli M. Noam, "Telecommunications Policy on the Two Sides of the Atlantic: Divergence and Outlook," op. cit., pp. 4-5.

[124] "Development Communications," Policy Determination PD 10, op. cit., p. 5.

[125] That goal was achieved: the original 1965 satellite with one Earth station in the United States, another in Canada and a few in Europe had led to a system of 15 satellites in 1984, covering three ocean regions with 981 operating or approved Earth stations in 172

The term "single global commercial" system implies to some that INTELSAT is to have a permanent monopoly over virtually all international communications carried by satellite, while others see INTELSAT as only one element, a major one to be sure, but only one, in the developing international telecommunications industry, where competition will also be an increasingly important principle.

INTELSAT argues that it receives sufficient competition from transoceanic cables and that this competition between transmission media will intensify in the future as the TAT-8 and other fiber optic cables come into operation in the period just before and after 1990.[126] Any more competition from private satellite companies, in the INTELSAT view, would further reduce the scale of **INTELSAT'S** operations and raise the price of INTELSAT'S services, since its costs would be recovered over a smaller volume of traffic. This judgment of higher prices, of course, would not hold true if a competitive market developed in which competition forced all satellite prices down, including INTELSAT'S.

INTELSAT officials fear that growing numbers of competitors to INTELSAT might result in the decline of the system and its eventual replacement by poorly connected regional systems. Several regional international satellite systems, described earlier in this chapter and in app. A, have **recently emerged. All have been through or are going through a process called the "INTELSAT coordination process, " in which proposed new international satellite services are presented to INTELSAT for a finding of whether they are technically compatible or in the case of "international public telecommunications services" whether they** will cause it "significant economic harm." Parties to the INTELSAT Agreement, including the United States, have bound themselves to go through the somewhat cumbersome consultation process in Article XIV(d) of the agreement with respect to proposed systems offering separate public international services, but are not obligated by the agreement to do more than that (see app. 6D of this chapter for the text of Article XIV and related parts of the INTELSAT Agreement) .127

The INTELSAT Assembly of Parties, a one-nation-one-vote body, which ordinarily meets biennially, is charged by Article XIV with making INTELSAT'S recommendations to the parties (governments) proposing to establish satellite systems separate from INTELSAT as to whether, in its opinion, they will or will not cause significant economic harm to INTELSAT.[128] To date INTELSAT has approved at least some of the services to be offered by the four regional systems, usually on the grounds that the communications services to be carried would not to any significant extent have been carried on INTELSAT, because they would have been carried on terrestrial media instead, or not sent at all. The Palapa, Eutelsat, and Arabsat systems have been approved for this reason, even though they carry international message telephone service and other communications of the type INTELSAT typically carries.

The development of a Western Hemisphere regional system composed of satellites and Earth stations owned by a diverse set of mostly private entities rather than by a regional organization of governments, however, has been delayed for several years because of INTELSAT coordination difficulties. By March 1984, the FCC had conditionally approved a total of 114 applications for regional international service in the Americas involving U.S. and Canadian domestic satellites, but

countries or territories. The number of telephone channels went from 150 to 60,000, while the annual tariff per voice half-circuit went from $93,000 to $4,680 [in 1983 dollars] (I NTELSAT Annual Report, 1983; converted to 1983 dollars using the U.S. GNP **deflator).**

[126]Testimony **of Richard R.** Colino, **Hearings Before the Subcommittee on Arms Control, Oceans, International Operations, and Environment, Senate Foreign Relations, 98th** Cong., **Oct. 19 and 31, 1983, p. 25.**

[127]A recent Administration policy **paper, however, asserts that the "United States is committed to ensuring that non-I** NTELSAT **satellite systems are technically compatible with existing and planned** INTELSAT **satellites and to avoiding significant economic harm to the global** INTELSAT **system (Departments of State and Commerce, "A White Paper on New International Satellite Systems," op. cit., p. 17.**

[128]The INTELSAT coordination **procedures and criteria of economic harm have not been fully developed, and guidelines are now under consideration within** INTELSAT. **If the proposed services are international but not public, they fall under Article** *XIV(e); if* **they are public but domestic they are coordinated under Article XIV(C), The Assembly of Parties has as yet not adopted an official definition of "significant economic harm, " the number of cases decided have been few, and the findings to date have in almost** all **cases been in favor of the proposed systems.**

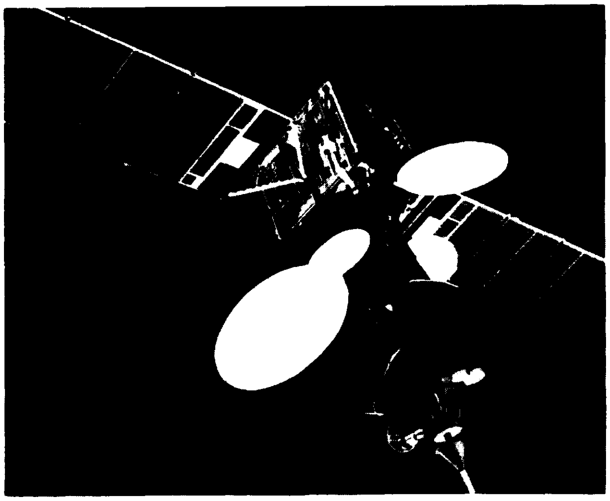


Photo credit: National Aeronautics and Space Administration

Artist's conception of INTELSAT V, for which the U.S. company Ford Aerospace was the prime contractor.

many of these were on hold awaiting State Department, foreign government, or INTELSAT action. As of March 31, 1985, the FCC had given final approval to 46 applications for services to Canada, Mexico, Central America, and the Caribbean. Although final approval has been given for extended data and television services between the United States and Canada, the only services that have been approved for most of the other destinations are television receive-only transmissions.[129] Thus, only part of the potentially large Western Hemisphere system is currently in place. In the future, this system could compete with INTELSAT.

Whether the INTELSAT coordination process for the other conditionally approved television and data services will go smoothly and whether telephony will ever be a service carried on the Western Hemisphere system is unclear at present. All the current applications that the FCC has conditionally approved have been approved on the grounds that they will not divert traffic from INTELSAT or that using INTELSAT would be economically wasteful.

At the present time, the U.S. Government (FCC and State Department) is taking the lead in overseeing the development of the Western Hemisphere regional system in response to market pressures, by: 1) approving applications of U.S. providers domestic satellite communications to provide "transborder" services; 2) establishing that the governments in the countries involved approve; and 3) carrying the bilaterally approved applications through the INTELSAT coordination process.

The key U.S. decisions about its policy toward INTELSAT will probably not be initially made on issues involving the Western Hemisphere, but rather on issues that concern what could potentially develop into a North Atlantic regional system, if any of its components come into existence. As described above, six private U.S. companies have applied for permission to construct and operate transatlantic communications satellites. Two of these are large corporations with communications interests—RCA (through its RCA Americom subsidiary) and United Brands (through its International Satellite, Inc. [ISI] subsidiary); four smaller firms—Orion, Cygnus, Pan American Satellite, and Financial Satellite—have also applied.[130] In response to this potential entry, INTELSAT has argued that open competition in transatlantic satellite communications facilities could mean the breakup of the INTELSAT system,

[129] Coordination of even this limited competition represented a significant departure from the previous situation. Until the meeting of the INTELSAT Assembly of Parties in January 1985, only 13 services had been given final approval by the FCC on the basis of INTELSAT coordination and only to Canada, Bermuda, and the Cayman Islands. At the January meeting, 19 U.S. and 6 Canadian satellite systems were coordinated, involving data transmission to and from Canada and television receive-only transmission to Mexico, Bermuda, Bahamas and 17 Caribbean and Central American countries and territories. Television services coordinated between Canada and the U. S., U.S. and Canada, and Mexico and the U.S. were point-to-point and point-to-multi-point in some cases.

[130] Orion, PanAmSat, and Finansat do not plan to offer any common carrier services, but the other three applicants (RCA, United Brands' ISI, and Cygnus) have stated their desire to use some capacity for common carrier service, in addition to business and media services, which they state to be their primary offering. The satellites of other countries, including those owned by noncitizens (analogous to flags of convenience in ocean shipping), are also potential entrants in transatlantic satellite communications. France and the United Kingdom are constructing satellite systems that will be capable of serving both sides of the Atlantic (the first French satellite has already been placed in orbit) to connect them to their North American and Caribbean territories. They have stated that they do not intend to compete with INTELSAT.

which U.S. diplomacy worked long and hard to put together in the first place.[131]

After many months delay, President Reagan in November 1984 determined that separate international satellite systems "are required in the national interest."[132] However, in an attempt to reduce the challenge to INTELSAT, the Administration set two criteria for the FCC to use in acting on the existing transatlantic satellite applications.

> . . . to assure that the United States meets its obligations as a Party to the Agreement Establishing the International Telecommunications Satellite Organization (INTELSAT):
> 1. each system is to be restricted to providing services through the sale or long-term lease of transponders or space segment capacity for communications not interconnected with public-switched message networks (except for emergency restoration service); and,
> 2. one or more foreign authorities are to authorize use of each system and enter into consultation procedures with the U.S. party under Article XIV(d) of the INTELSAT Agreement to ensure technical compatibility and to avoid significant economic harm.[133]

As of this writing, neither the Administration's nor the FCC's policy is clear concerning how many transatlantic systems will be authorized, how much capacity will be allowed, and, despite the interconnection prohibition, what the conditions on resale will be. Even if stringent connection and resale conditions were enforced, users of these systems would undoubtedly withdraw a nontrivial amount of transatlantic traffic from INTELSAT and send it via their own transponders (what they carry would not all be new demand). Hence, it is not clear that any of the systems would satisfy the as yet ill-defined criterion of avoiding significant harm to INTELSAT.[134]

If the United States should take the applications for private transatlantic satellite systems through the INTELSAT coordination process in collaboration with one or more other governments, as the executive branch now plans (providing the FCC conditionally approves the applications), and if they were rejected by INTELSAT for coordination, the stage would be set for one of the following five processes:

- U.S. denial of operating authority to all of the proposed systems.
- Unilateral U.S. conditional approval of operating authority to some or all of them, (They would then need to secure foreign connection rights from foreign regulatory authorities, with or without the good offices of the U.S. Government.)
- Bilateral governmental negotiations with one or more communications partners with the object of establishing bilateral regulatory regimes that would allow the operation of some or all of the systems, as well as systems proposed by these partners.
- Multilateral governmental negotiations outside of INTELSAT with the object of establishing a regional international regulatory regime for North Atlantic satellite communications that would also allow the operation of some or all of the systems as well as systems proposed by parties to the negotiations.
- Multilateral negotiations within INTELSAT to amend Article-XIV(d) so as to permit certain alternative satellite systems even though the permitted services might cause some degree of "economic harm."

Because the applications to provide international satellite communications involve facilities competition and, in the case of transborder and transatlantic business services, the possibility of single-vendor, dish-to-dish service, they provide a strong challenge to the current international regulatory order[135] Free markets in telecommunica-

[131] See written testimony (dated Nov. 14, 1983) of Richard D. Colino, Director-General of INTELSAT, before the Subcommittee on Arms Control, Oceans, International Operations, and Environment, Senate Foreign Relations Committee, Oct. 19, 1983.

[132] Presidential Determination No. 85-2, Nov. 28, 1984.

[133] Letter of the Secretaries of Commerce and State to the Chairman of the Federal Communications Commission, Nov. 28, 1984.

[134] The FCC inquiry will evaluate what economic effects the new systems would have on INTELSAT. (Mark S. Fowler, Statement on New International Communications Satellite Systems at Hearings Before, U.S. Congress, House, Hearings on International Satellite Issues before the Subcommittee on Telecommunications, Consumer Protection, and Finance, Apr. 3, 1985.)

[135] The uniqueness of international communications arrangements is not always appreciated. "Single-vendor service" is now the norm in U.S. domestic long-distance communications and always has been in virtually all other markets in the U.S. economy, and even in most other international service markets, Single-vendor service, however, is not the norm in international telecommunications service markets. U.S. basic telecommunications providers (and those

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tions are not considered desirable by most telecommunications partners of the United States. Consequently, U.S. moves that attempt to increase competition in the provision of international facilities are likely to engender conflict with some of our telecommunications partners in Europe, Japan, and elsewhere.[136]

In transatlantic telecommunications, U.S. approval of the six satellite applications, without prior agreement by *all* its major European communications partners, would amount to a major modification in the multilateral mechanisms—the North Atlantic Consultative Process and INTELSAT–that have been used in recent years to coordinate facilities decisions in that geographical sector. (The Administration's recently adopted policy requires only that "one or more" foreign authorities authorize new systems and be involved in the INTELSAT coordination procedures.[137]) Approval of the private cable applications would have a similar effect. If any U.S. moves to increase facilities competition should successfully obtain the collaboration of one or more U.S. communications partners, major changes in INTELSAT operations, as the consortium attempted to adapt to the new competitive environment, might be required. The principles that are employed in taking action in the case of the transatlantic applications will also set a precedent for similar Western Hemisphere and transpacific facilities.

If INTELSAT were in fact significantly damaged, then the United States would be blamed, justifiably or not, for helping to ruin the cooperative mechanism it had been instrumental in creating. U.S. telecommunications users might also lose from higher rates and poorer service, if the successor system performed poorly.

INTELSAT officials also maintain that INTELSAT now significantly subsidizes satellite communications for developing countries by means of averaged rates, but this is contradicted by analyses sponsored by the Orion Satellite Corp.[138] If there is a substantial cross-subsidy, then INTELSAT'S loss of revenues to competitors could lead it to raise rates for developing countries. Developing countries' displeasure over this, in turn, might then affect U.S. foreign policy interests.

A representative of one of the would-be new entrants suggested in testimony to Congress that consumers, in fact, would gain a number of benefits from competition to INTELSAT: advancing the general U.S. policy of favoring competitive markets, creating new markets, introducing new and more flexible services, lowering prices, and stimulating new technology.[139] The argument about the stimulative effects of competition (from alternative satellite or cable providers) is plausibly supported (at least *prima facie)* by INTELSAT'S announcement in October 1983 that it would accelerate the introduction of its "INTELSAT Business Service," offering firms facilities for dedicated international satellite telecommunications networks.[140]

Facilities Planning

Beyond the issue of satellite competition to INTELSAT from private U.S. satellite systems,

of other countries) are not free to offer single-vendor service in most international markets (i.e., to offer end-to-end communications service over their own owned or leased networks).

[136] See National Telecommunications and Information Administration, *Telecommunications Policies in Seventeen Countries: Prospects for Future Competitive Access*, May 1983 for a survey of country policies. Also Eli M. Noam, "Telecommunications Policy on the Two Sides of the Atlantic: Divergence and Outlook," op. cit.

[137] Letter of the Secretaries of Commerce and State to the Chairman of the Federal Communications Commission, Nov. 28, 1984.

[138] The existence and importance of a cross-subsidy to developing countries through the INTELSAT system is a complex issue that has been addressed in testimony before Congress by witnesses presenting material developed for INTELSAT and Orion Satellite Corp. See, e.g., Kenneth R. Dunmore, Hatfield Associates, "An Analysis of the INTELSAT Subsidy Issue, " August 1983 and "Issues in International Telecommunications Pricing and Demand," Nov. 27, 1984, both prepared for Orion Satellite Corp.; Walter Hinchman Associates, Inc., "The Economics of International Satellite Communications, " May 18, 1984, prepared for INTELSAT. The principal analytical questions revolve around what satellite capital cost should be assigned to different world regions, considering that satellites are movable, and the efficiency of transponder use when a single transponder is used by more than one country.

[139] Testimony of William L. Fishman (International Satellite, Inc.), *International Communication and Information Policy,* op. cit., p. 280.

[140] See Connections: *World Communications Report,* published by The Economist and Television Digest, Oct. 27, 1983, p. 2 and *Broadcasting,* July 4, 1983, p. 67. This conclusion was also reached in the Departments of State and Commerce, "A White Paper on New International Satellite Systems, " op. cit., p. 51.

there are two broader issues in facilities regulation:

1. Does the United States need to develop new international regulatory mechanisms to balance the use and/or construction of satellite and cable facilities?
2. Should U.S. regulatory authorities be concerned with the possibility of overcapacity in transatlantic telecommunications facilities?

Restrictions on facilities construction, ownership, and use are key elements in the present international communications regulatory structure and are the elements currently most under challenge. Carriers or other firms wishing to construct, purchase, or operate international communications facilities are not free simply to do so. They must apply to the FCC for authority, and the Commission has often used its power to delay or deny such applications on a variety of grounds. For instance, in 1984 the Commission decided not to allow firms to gain direct ownership access to INTELSAT, and private U.S. firms have not yet been allowed to own satellites for use in international communications, except within the limited Western Hemisphere regional system. (See app. 6A for further discussion of the issues in this section.)

The FCC also restricts the U.S. international service carriers in their use of communications facilities. In practice, this has meant that AT&T and other carriers have been required or induced to divide their transatlantic traffic between cables and satellites in approximately equal parts. Although the Communications Satellite Act of 1962 and the INTELSAT Agreement of 1973 endeavored to promote the use of satellites, incentives set up by the Act and the Agreement and by regulations based on them have had just the opposite effect.

This paradoxical outcome occured because, under U.S. regulation, carriers have an incentive to invest in and use their own cables in preference to satellite circuits leased from COMSAT, particularly at times of day and during seasons and periods when there is surplus cable capacity. These reasons involve the impacts of return-on-rate-base regulation, the tax code, and the fact that COMSAT'S tariff is greater than the variable costs of using cables. Once the distortion of incentives became apparent, the FCC decided to ameliorate the situation through additional regulation to limit the cable capacity of carriers and to secure the balanced use of the satellite and cable facilities in existence.

The FCC is currently considering what circuit distribution and facilities planning policies to implement in the 1985-95 period and has tentatively concluded that only AT&T's message telephone traffic should be forced to conform to a circuit distribution scheme during the period (all other carriers and AT&T's record traffic would be exempt).[141] It also tentatively concluded that AT&T should be gradually allowed to raise the proportion of its message telephone traffic transmitted by cable to 60 percent by 1991 (up from 48 percent in 1984). Based on AT&T projections, the FCC analysis is that this would allow AT&T to send 72 percent of its 1991 traffic growth by cable and would reduce INTELSAT'S revenues by $33 million in the same year.[142]

The FCC has also recently altered the regulatory structure to change COMSAT'S special role in the ownership of INTELSAT Earth stations. Previously, the U.S. international service carriers had been locked in a mandated Earth Station Ownership Committee Consortium with COMSAT. COMSAT owned 50 percent of the Earth stations and the carriers owned the rest. Now there is a COMSAT tariff purely for space segment services, and the carriers (and other users) are free, as they see fit, to own their own Earth station facilities and incorporate them in their rate bases or, akernatively, to lease Earth station capacity from COMSAT or other owners. One effect of the new FCC Earth station policy is to reduce (in only a moderate way, however) the bias **of** U.S. carriers toward cables.

Because the would-be satellite entrants arrived on the scene first, and because an intergovern-

1-11 FCC, "Second Notice of proposed Rulemaking In the Matter of . . . Authorization of Common Carrier Facilities to Meet North Atlantic Telecommunications Needs During the 1985-1995 Period," op. cit., pp. 20-32.

142 Derived from i bid., table following p. 34. The reduction in INTELSAT's revenues is in comparison with the "balanced loading" circuit distribution scheme used by the FCC at times in the past (see note 46, p. 161, for a definition of balanced loading).

mental organization (and its financial health) are involved, much of the public discussion has centered around satellite entry in competition with INTELSAT. In late 1984, however, the FCC received two transatlantic cable landing applications that may pose an even greater threat to the current regulatory regime and, consequently, to INTELSAT. They propose to add an estimated total of 330,000 voice-equivalent circuits in private fiber optic cables by 1990, four times the estimated 80,000 combined capacity of the TAT-8 and TAT-9 cables that the consortium of the North Atlantic carriers has discussed in the North Atlantic Consultative Process. By itself, the capacity proposed by the two new cable applicants is approximately four times the carrier demand forecasts for 1995.[143]

Such major capacity additions obviously raise the possibility of substantial overcapacity (discussed below), and they also threaten both the cable-consortium mechanism, which has heretofore built all transatlantic cables, and an international "institution," the North Atlantic Consultative Process. Once again, the challenge comes ostensibly in business communications, although the organizers of Submarine Lightwave Cable Co. do not exclude sales of capacity to common carriers like MCI. One of the two cable facilities is proposed by a major foreign carrier, Cable & Wireless Ltd. (with U.S. venture capital partners) and therefore also raises questions of international service competition in the United States.

These large proposed capacity additions–far in excess of demand projections—pose the question of whether there is a built-in tendency in the imperfectly competitive transatlantic telecommunications market for unrestricted freedom to invest to result in chronic overcapacity. A case could be made for facilities regulation, if consumers, rather than investors, would suffer the consequences of over-investment by having to pay higher prices. This could occur if investing carriers would be able to recoup losses from any "white elephants" by persuading regulators to allow high prices and restrict the capacity in use. Regulation of price and of the use of capacity creates an effective cartel, and facilities owners might be able to avoid the competitive consequences of over capacity investment and still earn high returns (supposing that demand responsiveness would not prevent it). The primary justification for facilities regulation, thus, is that price and capacity-use regulation can be even worse. U.S. use of facilities regulation can also be justified if price and capacity-use regulation is imposed by foreign authorities.

Considering the announced plans and the nature of the actual participants in the transatlantic service market, there is some realistic possibility that the supply of transatlantic capacity, in the absence of controls on construction, could far exceed the demand for it in the 1990s. if all the proposed capacity additions were actually constructed, capacity in 1992 would amount to about 650,000 voice-equivalent circuits,[144] compared to current expected demand (about 20,000 circuits in 1985) and the transatlantic demand forecasts of the U.S. international service carriers (USISCS) and the European CEPT carriers for 1995. Both of these 1995 forecasts are for approximately 82,000 voice-equivalent circuits (tables 6A-1 and 6A-3, app. 6A). Taking all estimates at face value, the construction of the proposed facilities would result in a very large excess supply.

[143] The TAT-8 cable (owned jointly by AT&T, other U.S. international service carriers, and European PTTs) was approved by the FCC in 1984. A similar TAT-9 cable is proposed by the consortium for 1992. The new cable applicants are: 1) Tel-Optik Ltd. (the U.S. venture capital partner of Cable & Wireless, Ltd., a British telecommunications carrier), which has applied to build two fiber optic undersea cables with capacity of 80,000 voice-equivalent circuits (FCC, File No. S-C-L-84-002, Sept. 28, 1984); and 2) Submarine Lightwave Cable Co., a U.S. venture capital group, which has applied to build a second cable facility with capacity of 250,000 voice-equivalent circuits (FCC File No. SCL-85-001, Oct. 16, 1984). In March 1985, the FCC informed the Secretary of State of its conclusions that the Tel-Optik application "meets the threshold reciprocity showing of the Cable Landing License Act and otherwise appears to be consistent with U.S. interests under the Act. " The SLC application was not acted on pending the receipt of additional information but no prejudicial finding was made. (FCC News, Report No. 3092, Mar. 4, 1985).

[144] This should be regarded as only a rough estimate of the circuit capacity of proposed facilities, since both the magnitude of circuit multiplication that will be possible for voice conversations (this estimate is based on a multiplication factor of 5), and the proportion of voice to other uses that do not use multiplication techniques, are uncertain. It is arrived at by adding the following rough estimates: Currently existing cables in service at that time (10,000), TAT-8 and TAT-9 (80,000), Tel-Optik cable (Cable & Wireless) (80,000), Submarine Lightwave Cable (250,000), separate satellite systems (RCA, Orion, et al.) (120,000), and INTELSAT (100,000+).

If the USISC or CEPT forecasts are even remotely realistic, much of the excess supply can be expected not to materialize as plans are reevaluated. Nevertheless, even if all the venture-capital groups drop out, just the announced plans of INTELSAT, the cable consortia (principally AT&T and the European PTTs), Cable & Wireless, and RCA would together still equal more than 300,000 voice-equivalent circuits. It is not at all clear that any of these large firms or consortia would drop out or scale their plans far enough back to reach the neighborhood of the demand projections, even if they could forecast demand (at the level of the USISC projection) with certainty. They might fear that scaling back, without the certainty that the other major players would also scale back, would expose them to an unacceptable loss of market share. Such behavior might occur u rider the existing conditions of imperfect competition if firms had full freedom to invest in facilities, especially if they could expect to recover the costs of the capacity from consumers via higher prices enforced by regulation.

The competitive solution would be to liberalize the entire market, allowing free entry in both the service and facilities markets. Overinvestment that resulted in lower rates of return would deter additional investment. In the long run, society's resources would be allocated optimally.[145] One advantage of the competitive solution, if it could actually be implemented, is that consumers would determine the types of facilities that would be utilized and the types of services that would be provided. They would also determine the mix of private and public (common carrier) networks.

Facilities regulation would be an alternative solution, using the methodology that the FCC currently uses or another that involves INTELSAT more formally in the process. Facilities regulation would have symmetrical disadvantages compared to the competitive model; there would likely be some level of regulation-induced inefficiency in the facilities mix, in the service mix, and in the mix between public and private networks. A second disadvantage is that facilities regulation might be used to maintain an uncompetitive, high-priced services market, if facilities regulation were used to make entry difficult for new service providers. Despite these potential defects, facilities regulation might still be justified if the possible excess supply of facilities suggested by the current facilities plans were considered to reflect a tendency towards either chronic overcapacity or chronic instability.

This brief discussion suggests that a clear prima facie case cannot be made either for unrestricted transatlantic facilities competition (in the current institutional context) or for facilities regulation. Much depends on the particular technical, market, and institutional characteristics of the transatlantic communications market involved: the size of the demand, the seriousness of any tendency by the institutions involved to overinvest, the actual magnitude of fiber optic economies to scale, and the cost effectiveness of alternative methods of communication security.

Entry for U.S. Service Providers in International Markets

The United States must also choose how aggressively to pursue liberalization in the general area of entry into international telecommunications service markets. The issue is: how can the United States assist the several dozen large and small U.S. corporations active in U.S. international satellite communications, plus those currently only in domestic satellite communications, to gain access to foreign telecommunications service markets? Should the United States adopt an aggressive posture at the risk of straining relationships with our principal trading partners?

Because basic telecommunications providers are not free to offer single-vendor service in most international markets (i.e., to offer end-to-end communications service over their own owned or leased networks), they can only gain entry to the U.S.-Country X market, if the PTT of Coun-

[145] This might not be true of imperfect competition. Regulated firms would have a tendency to overinvest, if they did not have to pay for their investment mistakes. A number of the participants in international communications are likely to act differently from competitive firms. AT&T, whatever its regulatory status, is likely to retain significant market power and might invest for strategic reasons, particularl y if there are important fiber optic economies to scale. Foreign PTTs, being for the most part government owned, might also have a tendency to overinvest in facilities for defensive reasons, if they had reason to expect a financial bailout in the case of loss and had monopoly power over rates, INTELSAT might have an incentive to overinvest for the same reasons as its PTT owners.

try X will allow them to connect. Even if they were able to enter, they would have to tailor the service they offer to the facilities and practices of the PTT.

Full liberalization in international telecommunications service would require single-vendor service, pricing freedom, and open entry for common carriers and private firms alike in both U.S. and foreign markets.[146] While full liberalization is very unlikely in the short run, the United States could pursue certain short- to medium-term liberalization objectives in order to increase efficiency in U.S. international telecommunications markets and also increase the access of U.S. carriers. It could attempt to:

- establish a right of connection for all U.S. common carriers to connect to foreign public networks on a nondiscriminatory basis;
- retain country-of-origin pricing;
- prevent deterioration in the ability of U.S. firms to lease international private lines overseas under flexible conditions and with prices related to facilities cost;
- develop beachhead rights for the two-way handling of international communications to and from foreign satellite ground stations by both U.S. common carriers and private firms [147] and
- secure the right of entry for U.S. value-added and data processing firms into foreign domestic markets.

One possible outcome of the current attempts by U.S. corporations to enter transatlantic satellite markets could be that even if private competition were permitted, it could be narrowly restricted to business communications that do not enter public-switched networks and effectively circumscribed on the ground in Europe. In this case the current international system would probably largely remain in place.[148]

Another possible outcome is that the data processing revolution, and the business communications involved in it, will simply overwhelm regulatory defenses and bring not only international liberalization but also substantial domestic deregulation in most industrial countries within the next 15 years.

A third possible outcome could be that great resistance will develop to change, in Europe in particular, and that deregulatory pressures from the U.S. side—from consumers, excluded carriers, and the U.S. Government—will mount. For instance, large consumers abroad might attempt (with U.S. Government toleration) to circumvent national regulation and high prices in certain countries, by routing a greater flow of communications to the United States via cheaper neighboring countries than they do now. This could force unwilling PTTs to lower their international rates to meet the competitive threat.[149] The conflict that could result from such a situation might so sour communications relationships that the United States could find itself with few allies within international organizations on matters of telecommunications.

International Trade in Satellite Communications Equipment

The issue in this area is what action the Government should take to try to assure fair international competition in trade in both space- and ground-segment equipment.

The United States is both a leading importer and a leading exporter of telecommunications equipment. It used to have a large overall positive balance of trade in telecommunications equipment, but the balance suddenly shifted to negative in 1983. Table 6-9 shows this deterioration for the whole category "telephone and telegraph equipment," data being unavailable for satellite communications equipment separately. A surplus of over $200 million as recently as 1982 has turned into an estimated deficit of $945 million in 1984 and a projected deficit of $1.7 bil-

[146] Single-vendor service can coexist with monopoly provision of local service under an access-charge arrangement.

[147] The import of this would be that a U.S. carrier or firm could use its own equipment or lease whole, not half circuits from INTELSAT or other satellite facilities providers.

[148] Eli M. Noam, "Telecommunications Policy on the Two Sides ofthe Atlantic: Divergence and Outlook," op. cit., pp. 13-14.

[149] *Data* Communications, "Users May Reap Benefits of Transatlantic Competition, " March 1985; Gary Stix, "PTTs Make Life Rough Overseas," *Computer Decisions,* Apr. 9, 1985.

Table 6-9.—U.S. International Telephone and Telegraph Equipment Trade, 1978-85 ($ millions)

Year	Exports	Imports	Surplus (+) Deficit (–)
1978	388	233	155
1982	829	626	203
1983	790	1,209	–419
1984e	795	1,740	–945
1985p	800	2,505	–1,705

Key: e = estimated; p = projected.

SOURCE: Derived from Department of Commerce, U.S. *Industrial Outlook 1985*, pp. 30-1, 30-5.

lion for 1985. The International Trade Commission has forecast that the deficit will continue to increase and will reach $3 billion by 1993.[150] Large exports to developing countries used to more than make up for a trade deficit in telecommunications equipment with other OECD countries. Recently, however, a number of changes in international trade patterns—the deregulation of the U.S. long-distance communications market and the elevated value of the dollar among them, together with continuing barriers to U.S. telecommunications exports in the other industrial countries—have resulted in both a disappearing surplus in trade with less developed countries and a much greater deficit with other industrial countries.[151]

Turning to satellite communications equipment, in particular, it seems clear that, absent trade barriers, the United States still enjoys strong comparative advantage in communication satellites. This also appears to be true in customer-premises Earth stations, except that the advantage of U.S. firms over Japanese ones in this area may be ephemeral. In standard INTELSAT Earth station components, DBS equipment and standard telecommunications equipment, comparative advantage in high-volume manufacturing operations appears to have been shifting away from the United States, first to Japan, and now to Hong Kong, Taiwan, and South Korea. The latter advanced developing countries all had large telecommunications equipment deficits in 1978, but in 1983 had substantial telecommunications trade surpluses.[152]

While fundamentals may govern the movement of certain components of the telecommunications equipment industry into less developed countries, particular factors have contributed to the decline of both the U.S. export share in telecommunications exports and to the vastly greater imports of telecommunications equipment into the United States from the other industrial countries.

Strength of the Dollar

The high value of the dollar (typically described as over-valuation) tends to make all U.S. exports, including telecommunications exports, less competitive in price. The dollar rose by 58 percent between 1980 and 1984 relative to other currencies[153] and a shift of this magnitude, seemingly unrelated to changes in U.S. comparative advantage, is large enough to overwhelm it in many sectors.

Unequal Access to Industrial Country Markets

Following the AT&T breakup at the beginning of 1984, which separated Western Electric (now AT&T Technologies) from its special corporate relationship with the Bell Operating Companies, foreign telecommunications equipment sellers are now able to compete in the U.S. civilian market on substantially equal terms with U.S. producers. This market has supported explosive growth of imports for several reasons—because of strong U.S, economic growth, because of the elevation of the dollar, and because of some shift in comparative advantage. Imports grew 93 per-

[150] Statement of Paula Stern, Chairwoman of the ITC, in U.S. Senate, 98th Cong., Committee on Finance, Subcommittee on International Trade, Hearing, Telecommunications Trade, June 26, 1984, p. 9.

[151] See Robert Eckelman, "A Study of the International Competitive Position of the U.S. Telecommunications Equipment Industry" in U.S. Department of Commerce, International Trade Administration, *The Telecommunications Industry (High Technology Industries: Profiles and Outlooks)*, April 1983 and International Trade Commission, "Changes in the U.S. Telecommunications Industry and the Impact on U.S. Telecommunications Trade," Investigation No. 332-172, 1984,

[152] Department of Commerce, U.S. *Industrial Outlook 1985*, p. 30-5. See Raymond F. Mikesell and Mark G. Farah, *U.S. Export Competitiveness in Manufactures in Third World Markets* (Washington, DC: Center for Strategic and International Studies, Georgetown University, 1980), p. 106ff for an analysis of comparative advantage patterns, which concludes that the United States continues to have comparative advantage in technology-intensive products.

[153] U.S. president, *Economic Report of the President*, February 1985, table B-104, p. 351.

cent in 1983, are estimated to have grown 44 percent in 1984, and are projected to grow another 44 percent in 1985.

The same is not true for U.S. manufacturers in most other industrial countries. The PITs of most such countries usually purchase telecommunications equipment from national firms. Sometimes they engage in extensive R&D, which is provided to national supplier firms without cost. The GAIT Government Procurement Code covers only those government entities that individual countries specify as being under its coverage. As discussed in chapter 4, most governments have elected not to place their PTTs under its coverage and the European Space Agency is not a party to it, so there is no question of, for example, accusing the Bundespost monopoly, of breaking international trading agreements by proposing to launch a German-made communications satellite without allowing U.S. manufacturers to bid on the project. In another example, the French Telecom 1 satellite system has been developed directly by the D.G.T (Direction General des Telecommunications), the French telecommunications monopoly. The radio and television broadcasting companies of most foreign countries are also government organizations, and, where possible, buy direct broadcasting satellites from their own national or regional manufacturers.

Despite the desire by foreign governments to buy locally, U.S. firms have nevertheless had important participation in foreign satellite projects. The current Japanese communications satellites, CS-2A and CS-2B, for example, were built by Mitsubishi Electric with the active participation of Ford Aerospace & Communications.[154] Although the French firm Aerospatiale is the prime contractor for the Arabsat regional system, Ford is doing 59 percent of the work.[155] Brazil has contracted with SPAR Aerospace of Canada to supply the Brasilsat satellite, but Hughes will actually build it. A primary objective of foreign national space programs has been to reduce dependence on U.S. suppliers, and although U.S. satellite suppliers may continue to supply major components or technical services, foreign programs will continue to try to do more on their own.

There are signs that some PTTs may in the future permit some competition in equipment purchases, but these signs are far from suggesting a wave of the future.[156] In 1980 the U.S. and Japanese Governments signed an agreement to open the Japanese equipment market to U.S. firms. This agreement has not so far resulted in substantial U.S. telecommunications equipment sales in Japan, and it does not cover imports of satellites themselves.[157]

Just prior to when the partial privatization of the Nippon Telephone & Telegraph Co. (NTT) and removal of its monopoly status took effect in April 1985, the Ministry of Posts and Telecommunications proposed regulations that, in effect, would give Japanese manufacturers almost veto power over which foreign telecommunications products could be introduced into the Japanese market. Furthermore, the restructured NTT would be given special competitive advantages.

Major changes in these regulations, which U.S. diplomacy (and certain Japanese industry groups) have been seeking from the Japanese Government and have obtained in principle, are:

1. that U.S. manufacturers be allowed to certify that their products meet Japan's standards, instead of having to submit individual products for inspection by a Japanese Government agency;
2. that trade secrets should not have to be submitted to a group containing representatives of their Japanese competitors; and
3. that a single agency would be set up to approve telecommunications products for sale in Japan, rather than the four specified in the draft regulations.[158]

In this instance, as in previous trade disputes between the United States and Japan, political maneuvering within the Japanese Government and bureaucracy has made implementation far from certain, despite the strong support the U.S.

[154] *Aviation Week and Space Technology*, Feb. 4, 1985.

[155] U.S. Congress, Office of Technology Assessment, *Technology Transfer to the Middle East*, OTA-ISC-173 (Washington, DC: U.S. Government Printing Office, September 1984), p. 210.

[156] See Dan Schiller, "The Storming of the PTTs," *Datamation*, May 1983, pp. 155-158.

[157] *U.S. Export Weekly*, Jan. 31, 1984, pp. 580-581.

[158] *Washington Post*, op. cit., Mar. 19, 1985, p. D1.

position has received from the Prime Minister. In Japan, as in other industrial countries, the old PTT **structure does not easily accommodate** international competition, even when it is altered.

In satellite communications equipment, the opening of the telecommunications market, if it should materialize, would primarily affect Earth station equipment and some satellite components. Even an open market would not guarantee success in the Earth station market, however; **in this market U.S. firms face a formidable competitor in** NEC, the leading ground station supplier internationally as well as in Japan. Japan's response to U.S. pressure to open its satellite procurement market was to give NTT the option to buy foreign communications satellites if it should wish to do so, but U.S. "officials would not venture to guess the extent to which it would result in foreign purchases.'"[159] Under the terms of the restructuring of the telecommunications service industry, new entrants will also be allowed to purchase foreign satellites, and U.S. satellite makers appear to be actively seeking sales.[160]

Questions of the openness of the Japanese market are likely to persist, given the history of the bilateral negotiations over the 1980-85 period, but there is at least some movement there.[161] Elsewhere in the industrial world, the European markets remain tightly closed to imports of satellites and much telecommunications equipment. In these circumstances, some U.S. firms have found joint ventures with European firms to be a partial substitute.[162]

Trade Barriers in Developing Countries

Given the barriers to equipment market entry in the industrialized countries, the major new markets outside the United States seem to be in the developing world and in smaller industrial countries that do not produce satellites or ground equipment. U.S. satellite manufacturers are in a particularly good competitive position to sell in those markets due to their technological dominance. In Earth station sales, U.S. firms are more on a par with firms from other industrial countries, particularly Japan. In the developing world, it should be noted, there are a variety of nontariff barriers to trade that U.S. manufacturers must cope with. These include adherence to equipment standards set by former colonial powers and the fact that the PTT buyers of satellites and satellite equipment, by dint of their governmental status, may make purchasing decisions not entirely on economic grounds.[163]

Foreign Government Export Support

Some U.S. firms also believe that other OECD governments offer better export financing for their firms than does the U.S. Export-Import Bank does for U.S. firms, despite the fact that the OECD Arrangement on officially supported export credit has reduced credit subsidies in regular export financing.[164] For some kinds of exports to developing countries, industrial countries combine foreign assistance credits with commercial export credits, i.e., "mixed credits, " an allowable practice under the current OECD arrangement on official export financing as long as the assistance meets certain criteria (see ch. 4), but one that the U.S. Government believes is being abused by France and Japan.[165] To counter an earlier use of subsidized credit by Japan in sales of Earth stations to less developed countries (in this case, an over-generous repayment period), the United States negotiated a special OECD Understanding on Export Credits for Ground Satellite Communication Stations. it provides for a maximum repayment term of 8 years in this case.[166]

159 *Washington Post,* **Apr. 28,** 1984, p. A20.

160 "Hughes **Pushes** Japanese **Ku-Band Allocation, "** *Aviation Week and Space Technology,* **Feb. 4, 1985, p. 72.**

161 **Lee Smith, "What the U.S. Can Sell to** Japan, **"** *Fortune,* **May 13,** *1985.*

162 For example, Fairchild Industries **has entered into a complicated joint venture agreement with Thompson** Alcatel **of France that involves each partner as a minority shareholder in subsidiaries of the other. The four jointly owned subsidiaries, two in the United States and two in France, will market pooled lines of satellite and terrestrial communications products and services** *(Washington Post,* **Washington Business Section, Mar. 11, 1985, p. 3).**

163 See **discussion above and also** *Technology Transfer to the Middle East,* **op. cit.**

164 John **N.** Lemasters, **op. cit., pp. 66-69. For** a general discussion of the OECD **Arrangement and the reprint of an unofficial version of its text, see Gary** Hufbauer **and** Joanna **Shelton** Erb, **subsidies** *in International Trade,* **Institute for International Economics, Washington DC, 1984,** ch. **3 and** app. **G, respectively.**

165 "U.S. **Warns France on Trade Issue, "** *Washington Post, Nov.* **28, 1984.**

166 Hufbauer **and Shelton** Erb, **op. cit.,** app. G, p. **224.**

Currently, the United States is attempting to obtain a significant tightening of the criteria for mixed credits and is threatening to retaliate with higher funding for U.S. mixed credits, if negotiations fail to produce the sought-after tighten ing.[167] An earlier example, where the United States matched foreign subsidized credit in satellite communications, occurred when ITT, a U.S. company, was attempting to sell an INTELSAT Earth station package to Cyprus in competition with a French company. Eximbank offered 85 percent financing at 6 percent, and the sale went to ITT.[168]

Other potential governmental means of supporting satellite communications equipment sales include: offering specially discounted combination packages of satellite and government-subsidized launch services (see ch. 4) or making countertrade arrangements in which satellite or ground equipment sales at ostensibly unsubsidized prices are tied to the purchase of commodities from the buyer at higher-than-market prices.[169]

U.S. Government Policy on Export Controls

In recent years there has been increased Government concern over the risk that exported high-technology equipment may fall into Communist, particularly Soviet, hands where it might be used for military purposes. One result has been increased vigilance over items which might be on the Department of Defense list of militarily critical technologies. At the same time, the United States has used export controls for political purposes–the most dramatic use being the withholding of technology and equipment that might be used to build the Soviet natural gas pipeline to bring gas to Western Europe.[170] These restraints on exports, whatever other purposes they may serve, affect the competitiveness of U.S. telecommunications equipment suppliers in international markets.

One case of note in satellite communications illustrates the problem. In late 1981 and early 1982, INMARSAT signed four contracts with U.S. companies (three with COMSAT and one with Digital Communications Corp.) in connection with the INMARSAT research program on the next generation of maritime communications satellites. Because the Soviet Union is a member state of INMARSAT and contract studies are available to all members, the U.S. Government delayed delivery of these studies to INMARSAT. Three of the studies were eventually delivered, but well beyond the contractual due dates, and one was completely canceled by INMARSAT.

INMARSAT officials expressed surprise at the export blockages, particularly since critical technical details did not have to be disclosed. INMARSAT required only enough information on the workings of the satellites to be sure they met performance specifications. With respect to the prospective delivery of actual U.S. satellites, no actual satellite equipment would ever actually be in the possession of INMARSAT, because the satellites would be launched directly from the United States or from French Guiana by the U.S. contractor. Responding to the U.S. action in this case, INMARSAT has decided not to accept bids on future contracts unless a firm can show that it has its government's permission to deliver the goods or services offered.[171]

Some U.S. firms see the application of export controls as putting them at a potential competitive disadvantage. As the vice-president of a firm manufacturing satellite Earth stations and other products put it:

> Too much time and effort is wasted in the U.S. on the so-called control of mature products which are already commercially available throughout the world. Control of technology must take place prior to the commercial introduction of a new product.[172]

[167] News conference of the vice chairman of the U.S. Export-Import Bank, Paris, Nov. 27, 1984.

[168] Robin Day Glenn, *Financing of United States Exports of Telecommunications Equipment*, International Law Institute, Georgetown University, Washington DC, 1982, p. 39.

[169] Douglas L. Adkins, "Countertrade, Clearing Arrangements, Reciprocity and Other Instruments of the New Bilateralism in International Trade, " unpublished paper presented at the Allied Social Sciences Association meetings, San Francisco, Dec. 29, 1983.

[170] U.S. Congress, office of Technology Assessment, *Technology and East-West Trade:* An Update, OTA-ISC-209 (Washington, DC: U.S. Government Printing Office, May 1983).

[171] See "INMARSAT Adds Contract Stipulations, " *Aviation Week and Space Technology, Nov.* 15, 1982, p. 25.

[172] John N. Lemasters, op. cit., p. 68. Mr. Lemasters is Senior Vice President, Communications Sector, Harris Corp.

The same official argued that export restrictions for foreign policy, rather than military, reasons was "the single most damaging U.S. action affecting U.S. exports, particularly to lesser-developed countries." He called the practice particularly harmful to the U.S. telecommunications industry, saying that customers would not buy from a country whose government might arbitrarily step in to restrict the flow of spare parts and maintenance services.

As OTA has **previously suggested, the national security and foreign policy benefits of export controls need to be weighed against the loss in export competitiveness to which they may sometimes lead.**[173]

The Advanced Communications Technologies Satellite Program

The key issues for Congress concerning the **NASA Advanced Communications Technologies Satellite (ACTS) program are:**

1. **how much should the Government spend on research and development to help** keep the U.S. satellite manufacturing industry technologically vital and ahead of potential foreign competitors? and
2. will the ACTS program do this?

In 1973 the Office of Management and Budget directed NASA to cut back research on civilian communication satellite technology on the grounds that the industry had matured to the point where it could provide its own research and development funds. **In 1978 the** NASA communication satellite program picked up again and conducted a proof of concept program on advanced satellite communications technology. Authority for elements of a demonstration satellite program (including a flight testing program) were included in 1984 appropriations.[174] The Administration proposed cutting back the program considerably for the 1985 budget, eliminating funds for the flight testing program, but interest in both the House and Senate in retaining the full ACTS flight test program has resulted in Congress funding the $354 million program with a $45 million budget in fiscal year 1985.[175] RCA is the prime contractor for the $260 million outside contract, and TRW and COMSAT are co-contractors;[176] Motorola, Electromagnetic Services, and Hughes are the major subcontractors.[177] NASA estimates that the contractors and other experimenters will spend an additional $100 million of their own funds on R&D that uses the test satellite facility or is otherwise closely related to the program.

ACTS will develop technology for Ka band (30/20 GHz) satellite systems and will also explore techniques for increasing satellite capacity that may have application in the C and Ku bands as well as the Ka band.[178] Operational satellites in the Ka band could be used to relieve crowding in the C and Ku bands. There is 2,500 MHz of frequency spectrum allocated for communication satellite use in the Ka band, compared to a total of 500 MHz in both the C and Ku bands.[179] Because of greater rain attenuation of signal in the Ka band (see fig. 6-3), however, special techniques, such as variable power level control to amplify the signal in compensation for the rain effects, forward error correction, involving signal redundancy, or alternative Earth station routings are necessary to use the band effectively.

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[173] *Technology and East- West Trade: An Update,* op. cit.

[174] Marcia Smith, "NASA's Advanced Communications Technology Satellite (ACTS) Program in Light of the Hughes Filing," Congressional Research Service report LTR84-158, Mar. 2, 1984 (Washington, DC: Library of Congress).

[175] *Aviation Week and Space Technology,* Aug. 6, 1984, pp. 24-25. The fiscal year 1985 program will continue ACTS technology development and activities leading to the flight program. Much of the $9 million appropriation for Communications Program research and analysis will be used for in-house research related to the ACTS program. U.S. House of Representatives, 98th Cong., 2d sess., Report 98-629, Committee on Science and Technology, "Authorizing Appropriations to the National Aeronautic and Space Administration for Fiscal Year 1985, Mar. 21, 1984, pp. 97-102.

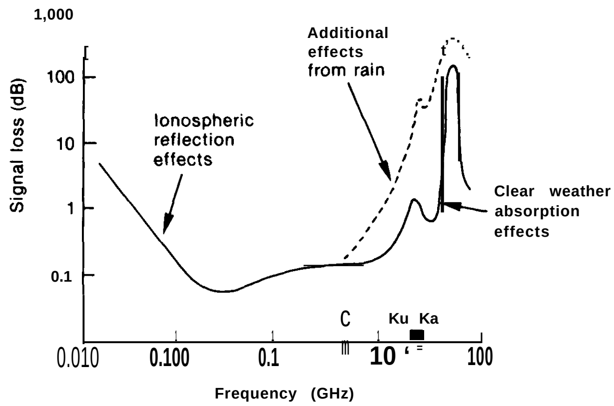
[176] The NASA program cost estimate was based on a 1988 launch, but this has now been moved into 1989 (*Aviation Week and Space Technology,* Aug. 6, 1984, pp. 24-25).

[177] Smith, CRS Report LTR84-158, Op. Cit., p. 11.

[178] This discussion draws on a number of sources, especially Smith, CRS Report LTR84-158, op. cit. NASA, Office of Space Science and Applications, "ACTS: Advanced Communications Technology Satellite Program" [undated pamphlet]; Chris Bulloch, "Advancing the Art of Satellite Communications," *Interavia,* January 1985, pp. 25-28; and C. Richard Whelan, "Communications Satellites Move to Higher Frequencies," *High Technology,* November 1984, pp. 49-53.

[179] An advantage of the Ka band, minimal orbital spacing (potentially 1 rather than the 2 or 3 degree spacing in the lower bands), is of little economic value unless there were also crowding in the Ka band, a possibility that is unlikely in any but the distant future (Whelan, op. cit., p. 49).

Figure 6-3.—Radio Signal Attenuation



SOURCE: National Aeronautics and Space Administration

Among the techniques that increase satellite capacity are those designed to increase the communications capability of individual satellites in given geosynchronous slots, called "frequency reuse" techniques. One such technique that the program would investigate is the use of spot beams, allowing the satellite to use the same frequencies simultaneously to transmit and receive different signals to and from geographically separate ground stations. On the ACTS test satellite, some of these beams would be scanning, sweeping back and forth from ground station to ground station. The scanning spot beams would further increase the total message capacity of the satellite by permitting fewer separate beams with higher power in each transmission. This scanning technique also would allow the satellite to redistribute its capacity continuously, following variations in service demand, to different areas of the country. Higher satellite power in beams would by itself allow the use of less expensive Earth station equipment, but a firm opposing the program contended that Earth stations required for the ACTS scanning-spot-beam technology would be more expensive than Earth stations required by satellites employing fixed spot beams.[180]

The program would also study increasing satellite capacity by a message processing procedure called "satellite switched time division multiple access" (SSTDMA).[181] SSTDMA is a technique of beam-to-beam digital switching within the satellite, which, though potentially useful with fixed spot beams, would be essential for scanning spot beams. An onboard computer, called a "baseband processor," would control scanning, switching, and other functions within the spacecraft.

During the period of low NASA effort in satellite communications research, individual European countries and Japan were all providing government funds for research in satellite communications technology and for the development of operational satellites in an effort to catch up with U.S. technology. One NASA study showed that, at $55 million in 1982, European expenditures were 2.5 times those of NASA, while, at $190 million, Japan's were 11 times NASA's.[182] Another estimate placed combined Japanese Government and private communications satellite R&D expenditures in 1983 at nearly $400 million.[183] Japan's current and planned satellites include fixed spot beams in the Ka band, as does Italy's Italsat, planned for launch in 1987. Satellites proposed by the European Space Agency, and by France and Germany separately, would also use the Ka band. None of the current foreign programs appear to contemplate movable or scanning spot beams, but Japan is considering a next-generation operational satellite system (cs-4) using scanning spot beams and onboard signal processing.[184]

U.S. firms have also carried out large corporate R&D efforts in satellite communications.[185] Nevertheless, industry and NASA officials have repeatedly told Congress that no private firm would be willing to bear the risk, expense, and delayed payoff of launching its own Ka band satellite incor-

[180] Smith, CRS Report LTR84-1 58, Op. cit.

[181] "By dividing the satellite communications signals into short, compressed bursts of information, several users may transmit and receive at the same frequencies by taking turns or time sharing. The time slot allocated to a given Earth station can be lengthened or shortened to accommodate a varying amount of communications needs." NASA, op. cit., p. 9.

[182] *Aviation Week and Space Technology,* Sept. 6, 1982, p. 241.

[183] R. Filep, A. Schnapf, and S. Fordyce, "Japanese and Western European Space Research and Development With a Focus on Communications Satellites, " paper prepared for NASA Lewis Research Center, Feb. 1, 1984.

[184] Bulloch, op. cit., p. 462-63.

[185] These efforts may have been stimulated by research for, or in anticipation of, military and INTELSAT contracts. Hughes, in particular, has developed advanced technology for the Department of Defense's MI LSTAR series of military communication satellites and for the INTELSAT VI series. Smith, CRS Report LTR84-158, op. cit., p. 13.

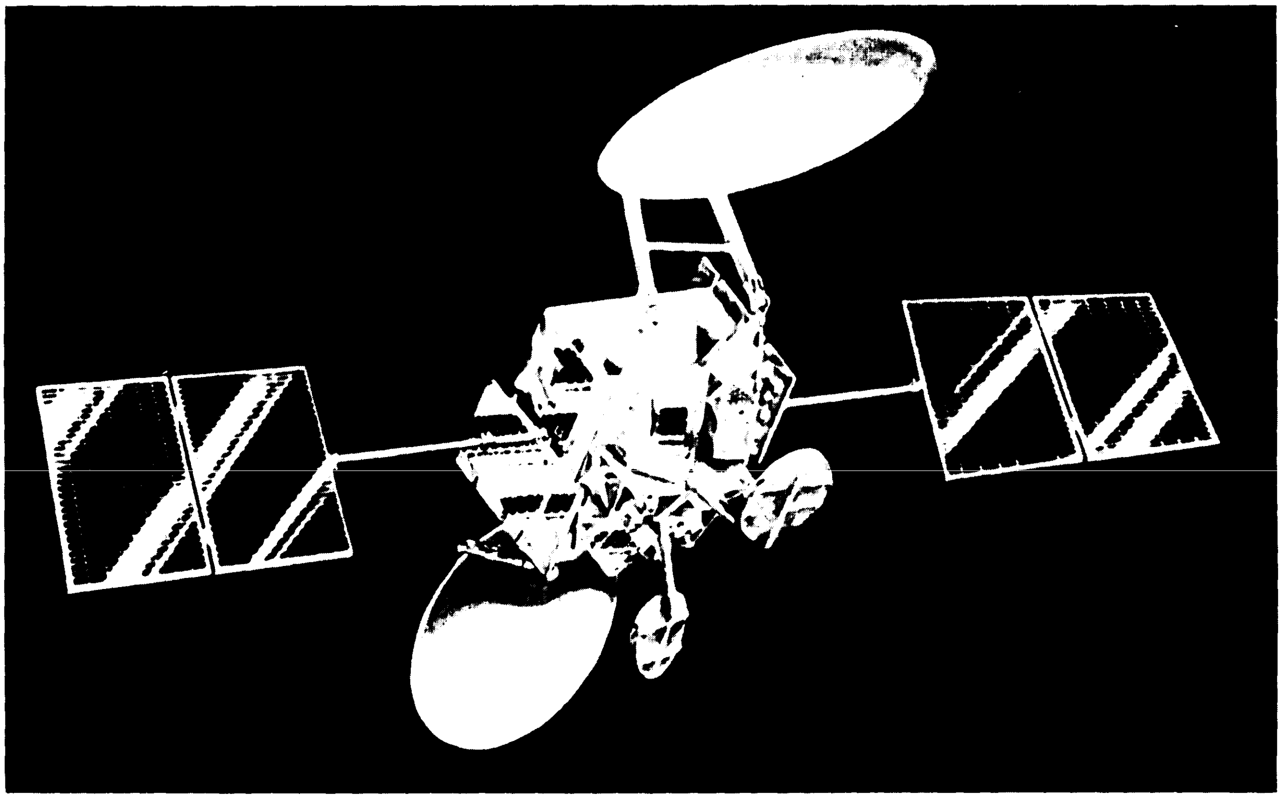


Photo credit: National Aeronautics and Space Administration

Artist's conception of the NASA Advanced Communication Technology Satellite (ACTS). The solar panels that provide the power are deployed on the left and right of the drawing. The reflectors for the 30 MHz and 20 MHz frequency antennas are shown above and below the satellite.

porating advanced technology. Were NASA not to test such a satellite first, their argument has been, the United States would lose its "pre-eminence" in satellite communications technology.

In 1984, however, Hughes Communications Galaxy, Inc., filed with the FCC for permission to construct, launch, and operate two Ka band satellites with its own funds in 1988 and 1989. The proposed Hughes satellites would have **16 spot beams, thus allowing multiple re-use of the same frequencies. The on board signal process**ing techniques would not include the SSTDMA planned for the ACTS satellite. The spot beams would all be fixed rather than scanning. According to Hughes, the simpler onboard system would allow the use of less expensive ground stations than those that would be required for the ACTS satellite.[186] On board switching circuitry would interconnect all 16 spot beams. The system in orbit was expected to cost about $450 million, to be financed with private capital.

Hughes officials argued scanning spot beam technology would probably never be economical for commercial satellites; there was thus no commercial reason for NASA to invest in that technology.[187] As for the advanced signal proc-

[186] It appears that **Hughes also has the ability to** install **movable spot beams in commercial satellites, at least at lower frequencies. The recent application by Pan American Satellite Corp. to provide international communications satellite service proposes to launch a hybrid system based on the Hughes HS-393 satellite with one "movable spot beam" and several fixed beams in 1987. The movable spot beam is designed to transmit in C band.** ("Application **of Pan American Satellite Corp. for a Subregional Western Hemisphere Satellite System, " May 31, 1984, before the FCC, pp. 15-18).**

[187] See Jay **C.** Lowndes, **"Hughes Plan May Spark Round of Ka band Filings,"** *Aviation Week and Space Technology,* **Dec.** 19, **1983, pp. 28-29.**

essing (called "baseband processing" to be explored in the ACTS), Hughes argued that NASA could do that research on the ground.[188]

The decision on whether the U.S. Government should fund the space testing of advanced satellite communications technologies depends on two classic arguments for government R&D as an element in the commercialization of advanced technology and on one argument unique to satellite communications:

1. The Government needs to protect U.S. industry's market share (jobs, exports, etc.) from the R&D subsidies of other countries by funding R&D of its own.
2. The Government should fund and possibly conduct advanced R&D in many advanced technology industries, such as aircraft, computers, telecommunications, etc., because the private sector systematically underfunds research that has two types of risks: the risk that the technology will not work or be saleable and the risk that competitors will be able to gain access to their expensive research as free riders. Industry therefore stays with proven, if older, technology.
3. In satellite communications in particular, only Government has the incentive to do research to guard against the misuse of a resource that is in **the** public domain, the geostationary orbit.

In satellite communications, as in other R&D contexts, evaluating the strength of these arguments is difficult because the chains of reasoning involved are complex and key facts and cause-effect relationships are highly uncertain. In satellite communications, there is no issue of the narrowness of the groups that would benefit from Government funding, assuming that the benefits were real. Every member of the public is a communications user.

How strong is the argument that unless the U.S. Government funds satellite research, the U.S. communication satellite manufacturers will fall behind their government-subsidized international rivals? In particular, determining whether the costly flight testing aspect of the ACTS program will be needed and effective in keeping U.S. firms competitive with foreign firms will have to deal with the following question:

- Will there be enough of a world market for Ka band satellites to justify a sizable research program of any kind on Ka band satellites?

A large market for Ka band satellites would exist only if there were substantial crowding in the geostationary orbit in the C and Ku bands, which in turn would occur in the 1990s only if the demand for U.S. domestic satellite communications expands very rapidly[189] The current glut in U.S. domestic satellites, the failure, as yet, of direct broadcasting satellites (DBS) to prove a market,[190] and the almost certain existence of an extensive U.S. fiber optic cable network in the 1990s, all make the existence of a Ka band market highly uncertain.

- Assuming that there will be a sizable Ka band satellite market, is the U.S. satellite manufacturing industry already competitive in Ka band satellites? At least one U.S. satellite manufacturer (Hughes Aircraft) asserts that it has the capability to build and market fairly sophisticated Ka band satellites, with technology as advanced or more advanced than the satellites in many of the foreign experimental programs.
- Will there be enough of a world market for satellites with scanning spot beams to justify a sizable research program on the necessary advanced techniques?

Depending on their cost, satellites with scanning spot beams might be purchased by satellite buyers so that they could increase the capacity of satellites in given orbital locations by more efficiently handling the communications of smaller cities outside of metropolitan areas and of rural areas. The actual cost and characteristics would be important, since other techniques of increasing the capacity of given orbital locations will be available, including the use of less sophisticated and less costly versions of Ka band technology.

188 Smith, CRS Report LTR84-1 58, Op. cit., p. 4.

189 See the discussion of the satellite equipment market above in this chapter.

190 "FCC Asked to Delay Radio Spectrum Shift," *Washington Post*, Apr. 9, 1985, op. cit., p. D3.

- Assuming that there are significant markets for satellites with Ka band and scanning spot beam features in the 1990s, will U.S. firms gain an advantage over foreign firms from the ACTS program or at least not lose the advantage they now have in commercial satellites? in part this depends on the usefulness of the results; can NASA's ACTS program, with the advice and significant financial participation of the private sector, "pick winners"? Whether U.S. firms would gain a competitive advantage also depends on whether foreign governments match NASA's research program with programs of their own intended to accomplish the same *commercial* objectives. Such induced programs might cancel or partly cancel the effects of the ACTS program on U.S. competitiveness. There is also the problem of NASA transferring the technology to U.S. firms and simultaneously preventing foreign firms from gaining access to it.

Turning from foreign competition to the basic role of government in advanced technology R&D, **how** strong is the argument that the private sector would not perform the socially optimum level of R&D **in satellite communications, if there were no** ACTS program? There is general agreement that the Government has a role in funding basic research, since the private sector has insufficient incentive to invest in it. Because an investing firm would not be able to keep its competitors from gaining substantial access to the research results, such an investment would usually not be profitable. If the basic research results are available to other firms through scientific publications or personnel transfer, they need not recover the costs of the basic research to stay in business and, in a competitive market, will tend to set their prices too low for the investing firm to recover its costs. The best way for a firm to avoid this situation is not to do the basic research. Private firms may also be too risk averse or too small to perform the basic research function. Consequently, government (and certain other research institutions) typically must do socially useful basic research, if it is to be done at all.

At the **other end of the basic/applied research spectrum, firms are much** more able to keep the results of applied process, product, and market research from their competitors and, thus, earn sufficient revenues from them to finance the research and earn profits. They can keep their research results secret as proprietary information, protect it with patents, incorporate it in engineering drawings and prototypes, and, finally, embed it in organizational practices. Much applied research and development is so intimately involved with the operations of firms and the characteristics of markets that only firms have the proper incentives to perform it well. Government organizations that try to perform highly applied research may end up with commercially irrelevant results.

To determine how much of the ACTS-type research private industry would do and what part the Government should fund, answers to the following questions should be sought:

- What kind of R&D have U.S. satellite manufacturers been doing by themselves? **In connection with the ACTS program, what kinds of coordinated research have the private participants been willing to finance from their own funds or in joint venture with other large aerospace, communications and information corporations? Using this evidence, what kinds of research would the industry be likely to do on its own? Considering that each of the three largest satellite prime contractors** (Hughes, Ford, and RCA) own or expect to own satellite capacity for sale or lease to customers, should they be expected to flight-iest innovative components on their *own* spacecraft? (The Hughes application promises to do just that.)
- How important, within the overall U.S. Government program of R&D in advanced technology, are those components of the ACTS program that only the government appears likely to perform? Which particular markets are they relevant to? The market for less sophisticated Ka band satellites or the market for satellites equipped with scanning spot beams and other sophisticated technology? Are either of these markets likely to be large enough to justify the cost of the ACTS program?

Finally, the unique argument in support **of satellite** communications R&D, which does not have a counterpart in the debates over other types of government-supported advanced R&D, is its relevance to potential crowding in the geostationary orbit. Certain questions need to be answered in order to evaluate the strength of the argument that Ka band satellites will be needed due to the crowding in the geostationary orbit:

- How likely is crowding in the geostationary orbit in C and Ku bands in the 1990s, considering the current satellite glut and the emerging domestic and international fiber optic networks? How damaging to the public interest would any crowding be that developed in the C and Ku bands, considering the existence of transmission alternatives.
- How much of the private sector's response to any crowding in the two lower bands would use existing frequency reuse techniques or less sophisticated Ka band satellites of the Hughes type, rather than sophisticated techniques, such as the ACTS scanning spot beams?
- How would crowding and technological responses to it be affected by any planning mechanisms decided on in the upcoming ITU Space WARC conferences?
- IS there a role for an auction techniaue to allocate the geostationary arc available 'to the United States in providing incentives to satellite manufacturers to develop arc-conserving technologies?

POLICY OPTIONS

This chapter has discussed and analyzed a number of elements in the U.S. international satellite communications sector. Implicit were various policy options. This section draws them out explicitly.

The Future of INTELSAT

The United States has three principal long-range options for dealing with the future of the international satellite communications system (INTELSAT augmented, as it currently is, by a number of coordinated regional systems):

1. It could attempt to preserve the current system, with INTELSAT continuing to carry the preponderant amount of intercontinental traffic and carefully controlled regional systems handling some intra-regional communications. Denial of the applications of private U.S. satellite firms to undertake large-volume transmit/receive operations across the Atlantic or within the Western Hemisphere would be consistent with this goal.
2. It might assert the freedom of U.S. satellite firms to offer substantial but not unlimited intercontinental transatlantic and Western Hemisphere satellite services, particularly in business and television communications, if it is satisfied that moderate competition in these areas would not jeopardize INTELSAT's financial performance. This objective could be pursued with the following short-run policy options:
   a. attempt to negotiate a regulatory regime with one or more major U.S. communications partners that would permit these services before licensing U.S. satellite firms to provide them, or
   b, license U.S. firms first, then negotiate the regulatory framework with communications partners later (or let the firms do it).
3. It could opt to abandon special support of INTELSAT; allowing U.S. firms to offer competitively as much and as many different kinds of international satellite and cable service as they wish (and can find interconnections for), and expect INTELSAT to adjust, with its survival a matter of its competitive success.[191] (I NTELSAT would, of course, continue to benefit from its monopoly position in non-competitive world regions.)

The question of competition to INTELSAT involves two conflicting objectives: 1) preservation of the "single global system" for foreign policy

[191] This option is not under active consideration by any of the policymaking bodies in the U.S. Government, but is included for completeness.

reasons and for its economic benefits, and 2) maximum competitive access for U.S. telecommunications carriers on grounds of fairness and the economic benefits that flow from competition. There is general agreement that U.S. policy toward INTELSAT in its formative stages engendered international goodwill and therefore furthered general U.S. foreign policy objectives.

In the United States, at least, there is support for the general ideas of increased competitive access for U.S. firms and fair international competition.[192] As discussed in chapter 4, competitive organization is the recognized normal form of industrial organization relied on by the United States in most domestic and international markets. In the specific case of international telecommunications, however, the U.S. consensus that competition promotes economic efficiency has been tempered by the fact that the United States simply does not have the power to create fully competitive conditions either by unilateral action or by entering into good-faith negotiations with communications partners. Competition in international telecommunications is not something that the United States can impose or that will happen if negotiations fail. Other nations have the unilateral power to disallow competitive arrangements when their territories are directly involved.

In the case of transatlantic entry, any U.S. satellite firms wishing to compete with INTELSAT will need the permission of one or more foreign governments to legally transmit into their territory. In cases where the public network is involved, it will also mean that the PTT will have to be willing to interconnect.[193] Even when the PIT is wholly government owned, formal permission by the regulatory authorities may not easily translate into actual connection by the PIT; when the PTT is partly or wholly private, resistance by an unwilling PTT may be even more of a problem. Reciprocal access of communications carried via foreign-owned satellites into the United States could be a condition for the entry of U. S.-owned satellite operations into foreign countries in many cases; foreign countries might alternatively insist on joint ownership as a condition for operation.

The three options listed above should be seen as different tradeoffs between the U.S. foreign policy objective of friendly relations with other countries and the economic interests of U.S. telecommunications producers. Where the interests of consumers lie is subject to debate and depends on how much competition would actually be established.[194]

Option 1 would attempt to prevent private competition to I NTELSAT in any but minor ways. Option 2 would move toward increased competition, while keeping INTELSAT viable. Option 3 would disregard any special consideration for INTELSAT and would move toward a competitive system if at least a small number of U.S. communications partners would let it.

In option 2, there is a significant range of tactical options between the extremes of "license first then negotiate" and "negotiate first for as good a deal as possible and then license in conformity with it." Because the United States does not have the power to remake the international regulatory regime unilaterally, if it decides to promote greater competition in international telecommunications, it should choose tactics that will help gain the agreement of the relevant foreign countries (and not harm general U.S. interests). Cases can be made for both of the tactical options listed or for something in between.[195]

For instance, would-be satellite providers could be given permission to construct (but not launch) their satellites, prior to the completion of the

[192] This consensus does not generally extend beyond U.S. borders, however, where the idea of competitive provision of "basic public services" by lightly regulated private companies is often severely criticized.

[193] Interconnection, however, does not mean nondiscriminatory treatment. For this to occur, the PTT would have to agree to send communications it originates via each of the U.S. carriers' satellite facilities (according to some formula) in competition with the INTELSAT facilities of which it is part owner.

[194] One argument in favor of option 2 is that it would allow some measurement of the performance of competitive satellite operations and thereby allow a better estimate of the costs or benefits to U.S. consumers, and to those in developing countries, of maintaining INTELSAT as a viable entity.

[195] See Bert W. Rein, et al., "Implementation of a U.S. 'Free Entry' Initiative for Transatlantic Satellite Facilities: Problems, Pitfalls and Possibilities" (Washington, DC: Wiley, Johnson & Rein, July 3, 1984); and Daniel P. Kaplan, "Buying and Selling International Airline Deregulation, " paper presented at the Allied Social Science Associations Meetings, Dallas, TX, Dec. 28, 1984.

INTELSAT coordination process. Construction took place in the Eutelsat and Arabsat cases prior to coordination. Alternatively, permission both to construct and launch satellites could be given but made contingent on completing the coordination process. In any case, there will be a mix of the unilateral exercise of sovereign power and of negotiations with communications partners over bilateral or multilateral communications arrangements.

The President has decided on option 2, in finding that alternative satellite systems (not connected to public networks) are "required" in the national interest, but has not indicated his tactical decisions.[196] To date the United States has conditionally approved applications by U.S. domestic satellite providers in the Western Hemisphere and may proceed to do the same for the prospective transatlantic satellite providers. What action the United States should take if INTELSAT refuses to coordinate some or all of the conditionally approved services is another important tactical issue yet to be joined.

In option 3 the tactical issues would not be so varied. For instance, because this option, to abandon special support of INTELSAT, would be the most disruptive of the current system, the United States' ability to negotiate it with most of its major communications partners in advance would be in great doubt. Hence, the license-first tactic is probably implicit in it. This, of course, would not **rule out the ordinary type of diplomatic interaction by which the Government** keeps its allies and trading partners informed of what it is about to do.

The Future of COMSAT

A separate set of policy options apply to COMSAT. Congress could:

1. Continue current legislative policy toward COMSAT, except with greater legislative oversight of the FCC's surveillance of COMSAT'S rate-of-return and its separation of regulated from unregulated activities. In this option, COMSAT would continue its monopoly status as the sole U.S. owner of INTELSAT investment shares and thereby as an intermediary in both traditional services and the new INTELSAT Business Service (IBS).
2. Mandate a rapid evolution of COMSAT into a fully competitive, general communications carrier, ending its special status at some specified future date by allowing other carriers direct ownership of or "direct access" to INTELSAT space segment facilities.[197]
3. Retain COMSAT'S monopoly as the sole conduit to INTELSAT, but restrict this role to the minimum and force divestiture of all other activities.

The fact that COMSAT is an ongoing, regulated enterprise that has managed the international satellite communications of the United States with technical effectiveness at declining prices to the carriers it serves and, as the U.S. signatory, has maintained good relations with U.S. communications partners is an argument in favor of option 1, to continue the status quo.

As the FCC sees it, this is an evolving status quo. For instance, several other communications firms are now allowed direct technical access to INTELSAT space segment facilities for INTELSAT Business Service (IBS), although they still must pay COMSAT'S tariff for their use.[198] Its Earth station decision also now allows carriers to own Earth INTELSAT stations.[199] The FCC also allows COMSAT to participate in other regulated and unregulated

[196] See previous discussion in this chapter of the Reagan Administration's 1984 decision to support limited operations by new satellite entrants.

[197] "Direct access" is the term used by the FCC to refer to various mechanisms whereby the other carriers could bypass COMSAT without actual ownership of an investment share in INTELSAT. Among the proposals the Commission considered (and denied) in its direct access decision were: 1) a capitalized lease option whereby the carriers would include in their rate bases the amounts they now pay COMSAT for circuit leases, and 2) an IRU (indefeasible right of user) mechanism similar to that used for cable facilites whereby the carriers would invest in INTELSAT circuits directly by paying COMSAT a prorata share of its investment in INTELSAT. The Commission also did not foreclose the possibility that it might revisit the direct access question in the future. (FCC, "Second Report and Order . . .," op. cit., Jan. 11, 1985, pp. 8-9).

[198] The executive branch has recommended that "cost-based carrier and user access to INTELSAT with respect of customized services" be ordered by the FCC but has not yet specified whether this is compatible with current IBS arrangements (Departments of State and Commerce, "A White Paper on New International Satellite Systems," op. cit. p. 33.

[199] FCC, "Second Report and Order . . .," op. cit., Jan. 11, 1985, p. 10.

communications markets, with strict separation of accounts and of elements of the corporate structure. In accord with FCC policy, COMSAT will now also be allowed to offer 1NTELSAT services to customers other than the international service carriers.

Options 2 and 3 would both make major changes in COMSAT's position. They might be attractive to those who have argued that, no matter how carefully COMSAT and its regulators attempt to insulate COMSAT's special role as the sole U.S. intermediary to INTELSAT from its other roles as a basic and enhanced communications carrier and equipment manufacturer, it cannot be effectively done. Thus, in this view, COMSAT would always be able to gain unfair competitive advantage from its special position.[200] The solution of option 2 is to end COMSAT'S special role, and that of option 3 is to restrict it only to that special role.

Option 2, to end COMSAT'S special role by allowing other U.S. businesses direct ownership of INTELSAT space segment facilities on the same basis as COMSAT could be difficult to implement, if it would require the agreement of the Board of Governors of INTELSAT or other INTELSAT bodies. Such agreement might not be forthcoming or might not be forthcoming on terms the U.S. would find acceptable.[201] Various direct access plans, which have been proposed to the FCC would allow the carriers to acquire ownership of assets from COMSAT, but depending on the arrangement, COMSAT might end up with a "ministerial role" in which it had large responsibility but little financial stake. If it did retain substantial financial stake (perhaps because the other carriers did not choose to or were not allowed to acquire assets proportional to their use of INTELSAT) the situation would be little different from the current arrangement.[202]

Option 3, which would restrict COMSAT (or a successor, perhaps governmental, entity) to its special, highly regulated role as the owner of and intermediary to I NTELSAT, would also remove the possibility that COMSAT'S special position in INTELSAT could be used to give it a competitive advantage in other activities, since it would not then have any other activities. This option could take diverse forms with diverse effects on market structure, however, depending on ownership and other restrictions that might be placed on the restructured COMSAT and on other changes i n the regulatory regime in international communications. For instance, if U.S. international carriers could gain ownership rights in the stripped-down COMSAT, such an arrangement could constitute a capacity cartel[203] and could make the current regime even less competitive than it is now.

Full assessment of the regulatory requirements under options 2 and 3 would require further analysis, but this brief treatment indicates that solutions designed to mitigate the competition problems caused at the domestic interface with INTELSAT are themselves likely to engender other, knotty problems of competition and regulation.

Satellites v. Fiber Optic Cables

The demand for international satellite communications services will undoubtedly continue to grow rapidly at least until the early 1990s, but between then and the end of the century, it may or may not continue to grow. The pace of that

[200] The fear that COMSAT **would be able to subsidize its competitive activities with revenues as monopoly provider of INTELSAT space segment services is one aspect, but information access is also cited. For instance, International Relay, Inc., stated in congressional hearings that the fact that COMSAT receives information prior to INTELSAT meetings that IRI receives only after decisions have been taken at those meetings is "critical to the future course of IRI's business plans, and those of others who are dependent on the INTELSAT system." (Statement of Steven A. Levy, U.S. Congress, House, Hearings on International Satellite Issues before the Subcommittee on Telecommunications, Consumer Protection, and Finance, June 13, July 25-26, 1984, pp. 156-185)**

[201] The **substitution of a new entity, perhaps governmental,** to **represent the United States so as to avoid the need to involve INTELSAT in the decision can best be seen as a version of option 3 to restrict COMSAT (or the new entity) to the role of owner of and intermediary to INTELSAT or as a separate option. See the following discussion of option 3.**

[202] **It should be noted that even if the carriers were allowed to gain ownership rights in INTELSAT, this would reduce but not eliminate their extra incentive to use cables rather than satellite transponders. Their traffic-sensitive satellite costs, which, depending on the exact arrangements, might be reduced from the COMSAT tariff to something closer to the INTELSAT unit charge, would still be greater than the minimal traffic-sensitive costs of using the cables they own.**

[203] The **term cartel is used here and elsewhere in this assessment descriptively to mean a group of firms that openly communicate with each other and reach joint decisions on such things as price, capacity, product offerings, market participation, etc. We do not use it to judge whether firms are in violation of the antitrust laws.**

growth will be conditioned not just by technology developments but also by choices that government will make with respect to facilities regulation, Options for the U.S. Government include:

1. Continue to control the amounts of transatlantic cable and satellite capacity available by approving or disapproving the facilities plans of cartels of U.S. and foreign carriers or of individual firms, and to oversee the loading of traffic on satellites and cables so that some form of balanced use of cables and satellites is maintained. Primary U.S. responsibility for international facilities regulation would remain with the FCC.
2. Same as above, except that no systematic policy of facilities balance would be followed. Technological competition between cables and satellites would be allowed. Action might be taken to reduce carrier bias toward cables, but other than this, the market, the carriers, and foreign regulation would be the primary determinants of the relative use of satellites and cables.
3. Leave U.S. telecommunications firms competitively free to invest in international cable or satellite facilities as they see fit and secure international connection rights as they are able. Reciprocal access for carriers using foreign-owned facilities is likely to be a condition for such connection. When entry to foreign service markets is limited, regulate the country-pair cartels that may arise to prevent high rates and the whipsawing of U.S. carriers.[204] Primary responsibility for overseeing the process would probably remain with the FCC.
4. Change to a more activist international-facilities policy involving a greater emphasis on bilateral government-to-government agreements on telecommunications facilities. Under this option, the United States would undoubtedly seek bilateral telecommunications collaboration with countries like the United Kingdom or Japan that are favorably disposed toward deregulation. In such a strategy there could also be room for multilateral communications agreements and for more general multilateral agreements on trade in services. This strategy would require more negotiation than the current regulatory regime and would be similar to the U.S. a: -preach to international airline regulation. The executive branch (National Telecommunications and Information Administration, the State Department and/or the U.S. Trade Representative) would be likely to take over the leadership in international facilities regulation from the FCC.

Option 1, to continue the present policy of controlling transatlantic communications capacity and its division between satellites and cables, has the attractive feature that it is a well-established policy in which flexibility can be obtained through ad hoc actions of the FCC. In support of current policy, INTELSAT and others have expressed the concern that unrestricted facilities competition between cables and satellites, in a still restricted international market, might result in:

1. excess capacity that consumers might have to pay for through higher-than-necessary prices, and
2. serious difficulty for INTELSAT with attendant political problems.

Nevertheless, a policy of balance–balanced construction and/or balanced use—could entail a large economic cost to U.S. consumers if the cost advantage of cables (or satellites) should prove to be substantial and if it required carriers and consumers to use facilities they would otherwise not choose to use.[205] A second question

[204] Whipsawing refers to a feared practice on the part of foreign monopoly PTTs in the negotiation of settlement rates with U.S. competitive carriers whereby the privilege of connection is awarded to the single U.S. carrier offering the highest accounting rate (or is awarded to each of a number of carriers based on what their offers are). Competition among the U.S. carriers could reduce their revenues, but the price of the end-to-end message could still be kept high if the favored U.S. carrier or carriers had to pay out monopoly profits to the PTT. See Evan Kwerel, "Promoting Competition Piecemeal in International Telecommunications, " working paper, Office of Plans and Policy, FCC, December 1984.

[205] Under a balance policy, a desired distribution of traffic between cables and satellites could result from either controls on construction or on use. If a carrier, carrier pair, or carrier consortium were convinced that the FCC would enforce a balanced use policy (e.g., 50-50 or "balanced loading"—see note 46, p. 161 for the FCC's definition of "balanced loading" between cable and satellite facilities), they would be unlikely to invest disproportionately in facilities they would not be allowed to use.

relating to balance is whether the existence of satellites should be guaranteed by government regulation so as to provide security against communications interruption or whether this function can be provided by redundant cable capacity.

Any large shift to cables would have important effects on INTELSAT and make it more likely that INTELSAT could become seriously unprofitable, so the issues of facilities planning and competition for INTELSAT are closely linked. The recent FCC recommendations of approval for approximately 330,000 voice-equivalent, transatlantic circuits in new private fiber optic cables, without much attention to its planning process, indicate that the Commission is acting without much regard for this link.

Option 2, to avoid any policy of balance but to continue to attempt control of total capacity, would leave the present regulatory regime in international communications largely intact, with the important exception that, if carriers were free to construct cables and did so, INTELSAT's share of transatlantic communications (and that of other satellite providers) would probably decline. This would represent a substantial change in policy toward both INTELSAT and COMSAT (see discussion of policy options on competition to INTELSAT, above.) It would have the advantage of partially meeting the long-standing objections of European PTTs to unilateral U.S. Government intervention in facilities decisions. (The favorable actions by the FCC and the State Department on cable landing licenses for large capacity private fiber optic cables, however, may have removed option 2 as a possibility.)

Options 3 and 4 would represent the abandonment by the United States of the North Atlantic Consultative Process as it is now structured and of INTELSAT'S position as the monopoly transcontinental satellite provider. They would also give freer rein to technological experimentation as individual cable and satellite operators (including INTELSAT) attempted to provide specialized facilities to meet differentiated market demands, Option 3, where the FCC would oversee the process of facilities decontrol, might have a number of outcomes depending on the reactions of foreign governments and the ability of consumers to circumvent restrictive regimes.

Option 4, the activist strategy of bilateral negotiation, however, would almost certainly move the international communications industry away from its present facilities structure, which on the U.S. side has till now meant the dominance of AT&T and COMSAT in the cable and satellite consortiums, respectively, along with the PTTs. Again, outcomes are difficult to forecast, but, for instance, the fortunes of the U .S, transatlantic satellite applicants and the U.K.-led fiber optic cable group could very well be the subject of a bilateral U.S.-U.K. communications agreement that would regulate the conditions of facilities competition. Such a bilateral agreement would be likely to include restrictive features; nevertheless, the United States might be able to secure enough facilities decontrol that there would be a large increase in competition in U.S,-U. K. telecommunications. Competitive effects, such as pressure on prices, might also extend to the wider market in other countries whose communications can reach the United States by transiting the United Kingdom.

Access of U.S. Carriers to Foreign Markets

The essence of the current regime in international communications is that U.S. carriers are barred from competing freely for the international communications business of either U.S. or foreign residents. With deregulation firmly entrenched as its domestic communications policy, the United States is now led to a number of specific objectives in international communications policy. In light of the fact that pursuit of these objectives might engender conflict with important countries, they can be analyzed according to the following options:

1. Give regulatory support and diplomatic representation to: a) carriers desiring to make voice and other connections with foreign carriers, b) data processing and enhanced telecommunications service providers wishing to service the needs of U.S. and foreign businesses, and c) U.S. multinational firms desiring to establish private communications networks. In this option the FCC and the Departments of State and Commerce would do

little more than facilitate carriers' efforts to gain market access.

2. Formulate an activist policy of bilateral negotiations to secure interconnection (particularly, message-telephone) rights in foreign countries for U.S. carriers. Where possible, attempt to stimulate competition in all aspects of international communications by negotiating direct access for U.S. firms to foreign consumers. The United States would likely be called on to extend equivalent access to foreign firms in the United States.
3. Seek to accomplish the same objectives on a multilateral basis through an effective GATT agreement on international trade in services.

Option 1 is essentially to continue present policy, with increased diplomatic representation for U.S. telecommunications service firms seeking access to foreign markets. Such a policy is feasible and desirable, as far as it goes, but it is doubtful that it would, in fact, result in market access in many countries in the face of continued foreign opposition. Only if domestic deregulation in our communications partners' home markets should proceed very rapidly, would effective access for U.S. firms be secured in this way without conflict. Even then, while domestic deregulation may be a necessary condition for access, it is not a sufficient one, since U.S. firms could still be excluded.[206]

Option 2, the activist policy of bilateral negotiations is probably the option that would achieve the greatest gains in market access for U.S. telecommunications service firms. In this option, substantial bilateral and multilateral conflict, engendered by U.S. efforts to export its deregulation policies into the international market, might entail substantial foreign policy costs in our relations with our principal communications partners, who, after all, are also our principal allies. The advantage of this option is that both the source of the conflict and effective negotiating strategies could be determined on a country-by-country basis. This option of bilateral negotiation would also allow the agreements reached with one communications partner to put liberalizing pressure on negotiations with another, since consumers might be able to circumvent the high prices of the latter country by routing their U.S.-bound communications via the former. This aspect of bilateralism might engender the greatest amount of conflict but also the greatest deregulation.

Option 3 (the multilateral option) would not appear to be any more likely to succeed than option 1 (the status quo) for telecommunications services as a whole, because any GATT agreement on trade in services would have to take account of the desires of the most restrictive countries. If and when domestic telecommunications is liberalized in all major OECD countries, significant gains in access for service firms could probably be made through multilateral understandings, but not before then. Nevertheless, a near-term multilateral agreement on trade-in services should be pursued in any case in the telecommunications area for the benefit of data processing and information firms.

The differences between options 1 and 2 are matters essentially of degree. They are distinguished by judgments about how much diplomatic capital to spend on attempting to gain access for U.S. telecommunications service firms in individual countries, particularly when the attempt engenders conflict. If a significant effort (option 2) is chosen, the fact that there are many U.S. actors on the international telecommunications scene who officially or unofficially negotiate with foreign government entities—notably the FCC, the State Department, NTIA, COMSAT, AT&T, the other international service carriers, and, now, the would-be satellite and cable providers—raises the question of whether effective negotiations to serve the national interest can take place outside the framework of formal bilateral communications agreements.

[206] That this will happen is the conclusion of one knowledgeable European observer (Guy de Jonquieres of the *Financial Times*). He notes that, while the PTT ministers of the EEC have agreed to open a small percent of PTT procurement to competitive bidding, it is only for the benefit of bidders from European countries. He specifically expects most European, governments to continue to restrict the opportunity for U.S. firms, in particular IBM, to enter telecommunications markets unrestrictedly. (Text of speech to the USTSA, Washington DC, Apr. 17, 1985, pp. 41, 45.)

International Trade in Satellite Communications Equipment

Freer trade in telecommunications equipment would help two important sectors in the United States—consumers of telecommunications services, who benefit from using whatever cheaper or better imported equipment might be available, and the satellite communications equipment industries, which would like to export more to currently restricted markets. U.S. options for reducing barriers to international trade in telecommunications equipment include:

1. Continue to follow a quasi-multilateral approach through the GAIT process of opening access to government procurement and the OECD process of controlling the terms of export finance. This involves bilateral negotiations to persuade other governments to put their PTTs under the government procurement code (or an equivalent agreement) and to regularize their use of mixed credits. Major departures from most-favored-nation treatment of U.S. trading partners would be avoided in this option.
2. Aggressively enforce more trading reciprocity by political persuasion, threats of retaliation, and bilateral negotiations. Take more positive government action to promote U.S. exports through subsidized export credits and industrial policy. If reciprocal market access can not be brought about, take steps selectively to close the U.S. market to countries that restrict U.S. exports.

Opinion appears to be divided over whether the current policy, option 1, will actually be effective in opening the Japanese market to U.S. satellite equipment exports. (It is not expected to do so in the immediate future.[207]) It clearly has not opened up European markets, although these markets, particularly for specialized telecommunications and data processing equipment and components of satellites and Earth stations, are not completely closed.[208] Despite the U.S. success in negotiating the bilateral agreements to open the wider Japanese telecommunications market to U.S. suppliers, the Japanese satellite market was specifically placed off bounds to foreign suppliers in 1984, even though Japan is in the special position of having an embarrassingly large trade surplus with the United States, The United States later succeeded in having this restriction partially removed, but how much actual effect on sales this will have is uncertain.

Were the United States to single out satellite communications equipment as a special target for reducing trade barriers in European producer countries, it would be an especially difficult task. On the one hand, many European countries, rightly or wrongly, see U.S. satellite equipment makers as heavily subsidized—earlier in their development by NASA, more recently by DOD. Those countries which potentially offer competition to U.S. satellite manufacturers have devoted large government resources to try to reduce their national dependence on U.S. suppliers. While they have been willing to purchase U.S. technology where necessary, including satellite subsystems, they are not eager to see their fledgling industries outcompeted by technologically more capable U.S. competitors.

Option 2 would take more aggressive government action to promote exports and secure reciprocal market access. It is an alternative to striving for a more open international trading environment in satellite communications equipment. Exports might be supported by making Government-subsidized export credits available, by attempting to use political influence to promote foreign sales, or by using foreign aid programs to subsidize sales to developing countries through mixed credits. Government subsidy of export activities involves distortions in the operation of the market system. Insofar as other countries seem to be engaging in these practices, the United States may decide that in defense of its own firms it can do no less.

207 telecommunication equipment as a whole in 1983 the Department of Commerce forecasted that Japan would import only $210 million in 1986 from all countries, compared to a total Japan market of $6.5 billion and Japanese exports of $2.6 billion. (International Trade Administration, "Country Market Survey: Telecommunications Equipment, Japan, " April 1983. Nevertheless, Japan appears to be making an unprecedented effort to encourage imports (Susan Chira, "Japan Urges Companies to Buy Foreign Goods," New *York Times,* Apr. 23, 1985).

208 Several U.S. telecommunications equipment firms have also formed joint ventures with European firms with the object of thereby gaining some access to their markets, among other reasons (e.g., AT&T with Olivetti and Fairchild with Alcatel-Thompson).

Imposing retaliatory trade barriers in the U.S. market in order to secure the opening of foreign markets might succeed, or it might engender further retaliatory measures by the countries targeted.[209] Because they involve breaching the most-favored-nation principle, engaging in such practices in many sectors runs the risk of inducing escalator responses from other governments, ultimately restricting international trade as a whole and leaving everyone worse off.[210] Judicious use in individual sectors, such as telecommunications equipment, could serve the purpose of indicating the seriousness with which the U.S. regards the barriers in those sectors and could serve as a bargaining chip.[211] Even if the Government should decide to use public resources to support particular industries, whether satellite communications should be singled out in the competition for such government resources would remain to be determined. There are, of course, many other national demands for government budgetary resources in addition to export subsidies, a fact that has led the Reagan Administration to propose the curtailment of Export-import Bank funding in the 1986 budget.

Research and Development Subsidies

Another way of attempting to improve the international competitive position of the U.S. satellite equipment industry would be for the Government to carry out research and development in advanced communications technology that private manufacturers seem unwilling or unable to finance with their own resources. This is just what is being done in the NASA Advanced Communications Technologies Satellite (ACTS) program.

Since Congress provided funding for the ACTS program in the current budget, the following options relate to the scale of the program in future years:

1. Fund the full ACTS program, in one of its existing versions, including the flight test of the experimental satellite.
2. Continue to fund the research programs on the ground but postpone from year to year a decision on construction and flight testing of the spacecraft until clearer support for one or more of the three supporting arguments discussed earlier occurs. For example, the United States might want to postpone commitment to a space test until a sizable market for satellites with scanning spot beams emerges and potentially competitive government programs abroad have committed funds to space testing of similar technology.
3. Continue funding only for those research programs that can be developed on the ground (e.g., the baseband processor for onboard message switching), but make a decision to leave flight testing and its funding to the private sector, at its option.
4. Return NASA satellite communications research to the very low levels of previous years, leaving responsibility for maintaining U.S. competitiveness in communications satellites to the private sector.

Budgetary and foreign response considerations will clearly continue to weigh heavily in future decisions on the ACTS program as they have in the past. There are significant arguments in favor of the program—promoting the international competitiveness of U.S. satellite manufacturers, the economic efficiency of the U.S. economy, and the danger of orbital crowding (see discussion of these arguments above). If none of these arguments in favor of the program are deemed to be strong enough, the U.S. Government would certainly be able to apply the significant resources of option 1 to other NASA projects, to other Government purposes, or to deficit reduction. A lot depends on whether sizable markets for either Ka band satellites of any kind or for ones incor-

[209] Occasioned by the $37 billion 1983 bilateral trade deficit with Japan, a number of legislative proposals have been directed at the overall trade deficit and at the telecommunications equipment trade deficit in particular, among them a 20 percent surcharge on all imports from Japan for 3 years and a boycott of Japanese telecommunications equipment until the Japanese telecommunications market is fully open (Washington *Post*, Jan. 27, 1985, p. D1). See also U.S. Congress, Senate, Committee on Finance, Hearings on the Telecommunications Trade Act of 1984(S.2618) Before the Subcommittee on International Trade, Sept. 12, 1984.

[210] U.S Congress, Joint Economic Committee, "1985 Joint Economic Report," Washington DC, Apr. 18, 1985, ch. 6.

[211] Congressional statements also have an impact, Such statements at a March congressional hearing were reputed to have "shocked the Japanese and may have contributed to their willingness" to alter complex proposed telecommunications products regulations that would disadvantage U.S. suppliers *(Washington Post,* "Japan Softens Stance in Trade Talks, " Mar. 19, 1985, p. D1).

porating ACTS-type sophisticated scanning spot beams can be realistically forecasted.

Options 2 and 3 are ways of hedging the Government's position by limiting it to the relatively less expensive, but arguably critical research that can be done on the ground. Option 2 would give the U.S. Government a way of waiting to see if foreign governments are first attempting trade-impacting R&D before it does the same. At the present time foreign governments have not yet committed significant funds to flight test programs for satellites with such advanced features as scanning spot beams. Congress could take the wait-and-see attitude implied by option 2, with the risk that the time lags involved could give foreign manufacturers a significant, avoidable advantage. It would open the possibility that the executive branch could reach an understanding with specific foreign governments about the level and type of their export-relevant R&D subsidies for communication satellites. The funding level and nature of the ACTS program could be the U.S. bargaining chip in such discussions.

The case can be made here (as in other R&D contexts) that the Government's best contribution is at the research rather than at the development stage. The more general the research, the less danger that the Government, in attempting to pick the specific configurations of ideas that the rapidly changing satellite market will adopt, will pick commercially nonviable ideas. Option 3 would take the Government out of the expensive and risky development end of the business. h would also preclude the research planned by the private sector from its own funds using the experimental ACTS satellite. Of course, the absence of a government development program might in the longer run stimulate private sector development efforts.

The Government could also use either option 2 or 3 to wait until the outcome of technological competition between fiber optic networks and satellites in U.S. domestic communications—and thus the demand for communication satellites—becomes clearer. There is a clear possibility that both domestic and international fiber optic networks will have sufficient capacity and coverage by the mid-1990s that new communication satellites will be priced out of the market for volume communications. In that event the eventual market for the ACTS innovations could be too small to justify a large program.

Option 4, essentially the abandonment of an ongoing program funded by Congress, would be an extreme measure (perhaps justified by the general budgetary situation), because much of the potential future benefit from the current research effort would undoubtedly be lost.

Participation in the International Telecommunication Union

In the face of growing "politicization" of ITU conferences and technical committees, the United States seems to have three broad options. It could:

1. stay in the ITU but take an increasingly confrontational posture, using the threat of withdrawal from the organization to attempt to prevent votes against the maintenance of principles important to the United States;
2. reduce or end U.S. participation in the ITU and establish U.S.-led, ad hoc international arrangements for sharing the radio frequency spectrum;[12]
3. attempt a more flexible approach in which a broad range of telecommunications and other issues, negotiated in the ITU and elsewhere, are treated as "linked." The emphasis here would be on a centralized bargaining strategy with developing countries intended to maximize U.S. interests across the board. In this option, U.S. delegations to conferences and committees would need to have very high levels of both telecommunications industry and foreign policy knowledge.

The United States faces a dilemma here. On the one hand, the international regulation of telecommunications seems to some observers to be in danger of further politicization and of bloc voting to the detriment of U.S. telecommunications and other interests. Option 1, a confronta-

[12] For a fuller discussion of these options and the middle course of participating fully in the ITU but adhering only selectively to its agreements, see National Telecommunications and Information Administration, op. cit., pp. 35-55.

tional approach within the organization to meet this, has been been discussed within the Administration as a means to minimize the damage to U.S. telecommunications interests (e.g., in the allocation of the geostationary orbit) without inducing the breakdown of the international telecommunications system.

In option 2, withdrawal from the ITU, the United States faces a significant risk of a breakdown in the international system of assigning radio frequencies and developing international standards for telecommunications equipment. The United States also runs the risk that if the international system continued to operate without U.S. participation, it might act with increasing disregard for U.S. interests. Either a proliferation of inconsistent national regulations or a coherent international regime that was injurious to the United States could develop and damage both U.S. economic and national security interests. It is not clear that U.S. technical leadership and economic power would suffice to induce the international community to follow U.S. telecommunications preferences in the absence of our participation in the ITU.

Option 3 is the diplomatic option, where the avoidance of conflict continues to be an important value in U.S. foreign policy. It might lead to the United States being induced to accept a spectrum-and-orbit regulatory regime that we would otherwise oppose. The attractiveness of this option depends on how important the linkages to other foreign policy objectives are and on how deleterious the ITU actions opposed by the United States might be. Because important U.S. economic and military interests are dealt with by international bodies that regulate the spectrum and orbit, as is rarely the case in other individual international fora where the United States can be outvoted by developing countries, the United States is likely to prevail in the ITU in the face of significant opposition only if it is willing to make a large investment of political and economic resources in a variety of bilateral and multilateral contexts. For this reason, options 1 and 2, where the United States would attempt to live with significant defeats in the ITU and would thereby save the investment of resources that it might have to make under option 3, could be more attractive budgetarily.

Assistance to Less Developed Countries

Assistance in satellite communications is one among many potential elements in U.S. aid programs. Because of the large number and complexity of individual country programs, because program elements are interrelated, and because host-country government officials are actively involved, Congress necessarily leaves detailed planning of such programs to program officials. For example, the role of receive-only rural satellite transmission, through which educational television programs can be made available to villagers, is viewed by Al D in the context of the actual agricultural and social development activities to which the information is related and in comparison to alternative means of accomplishing the educational objectives. The role of satellite communications in national systems of addressable telecommunications–telephone, telegraph, and telex—can also only be assessed effectively in the context of the country involved, its existing and planned national telecommunications system, its existing and planned domestic regional telecommunications systems and its development program.

Satellite communications options, like those concerning other aid program elements, are typically formulated at the program level, even if higher levels in the U.S. Government may ultimately become involved in program and funding decisions. This country-specific nature of assistance programs makes it difficult to formulate general options for satellite communications assistance, ones that would have worldwide applicability, and the more detailed country-program options that might be formulated for given countries' use of satellite communications are outside the scope of this assessment. Consequently, we do not set out options for development assistance in satellite communications here. Rather we highlight a number of issues in which satellite communications figures prominently, which Congress may **find it useful to explore with relevant officials** in its oversight of country development assistance programs and the export credit program.

Country-specific considerations for satellite communications include:

- the goals of U.S. assistance in the country (i.e., the relative emphasis given to rural development, regional development, industrial development, social and institutional development, general support of the regime, the support of particular power centers and institutions within the country, etc.);
- the extent of U.S. and other industrial-country use of mixed credits for financing equipment exports to the country;
- the volume of assistance the United States gives to the country through bilateral v. multilateral channels;
- the philosophies toward development policy of the country's government and the various donor agencies and organizations through which the United States gives assistance (e.g., AID and the World Bank);
- the presence or absence of special country characteristics enhancing the usefulness of satellite communications, such as large geographical size or insularity and other factors that limit the feasibility of terrestrial transmission modes; and
- the difficulties that the country has had or is likely to have with technology transfer in advanced technology systems—particularly in training and maintenance.

This variety of country-specific considerations demonstrates the difficulty of formulating general policy options toward satellite communications assistance. Often the issues that are relevant to satellite communications are either country- or program-specific or they are embedded in issues whose scope reaches far beyond the relevant satellite communications aspects. Nevertheless, several issues in which satellite communications figures prominently can be highlighted:

1. **How** much emphasis, financial and otherwise, should U.S. development assistance programs give to the development of a country's general telephone/telegraph/telex infrastructure, as opposed to the communications components embedded in particular agricultural, health, education, industrial, and regional development projects.[213] Current AID **policy prefers the embedded component approach.**[214]
2. **Are there development assistance programs** for specific countries that Congress can identify as underinvesting in satellite communications technologies for rural and remote area residents? New technologies allowing much smaller and less expensive receiving dishes and other advances are important reasons to make this examination.
3. Should Congress finance more satellite communications R&D directed specifically at the needs of developing countries?
4. Given the differing goals of U.S. programs in various countries, can countries be identified in which U.S. mixed credit financing of satellite communications systems is indicated on important development assistance or political grounds (in addition to its usefulness in financing exports of U.S. satellites and ground equipment or protecting against the mixed credit programs of other countries)?
5. What are the relative political advantages for the United States of multilateral v. bilateral telecommunications assistance programs compared to the general thrust of the U.S. aid program? Considering U.S. need to deal with developing nations within international telecommunications organizations, does telecommunications constitute a special case for directing relatively more (or relatively less) assistance through multilateral channels (e.g., the Center for Telecommunications proposed by the Maitland Commission or the World Bank)?

[213] In early 1985 **the Senior Interagency Group on International Communications and Information Policy recommended to the National Security Council that the telecommunications development** be given strategic priority on the U.S. foreign policy agenda because of the desirability of promoting the free flow of information, U.S. exports, and economic development ("U.S. Development Communications Assistance Programs, " Feb. 1, 1985).

[214] See Policy Determination PD-1 O, U.S. Agency for International Development, op. **cit., Feb. 17, 1984.**

Synthesis

A theme that runs through this discussion of specific policy areas is that there is frequently a tension between international competition and cooperation as means to further the U.S. national interest. Avoiding excessive conflict with other countries through international mechanisms (cooperation) is an important value in itself. But so is the furtherance of the legitimate objectives that the United States has in support of its consumers and producers. These objectives may often require the furtherance of competition, which, in turn, may engender conflict. A broad judgment about how the United States should most effectively make its way in the general world of cooperation and competition, then, is one of the key factors in choosing among the various options presented for specific satellite communications policies and is an important link with the Government's broader international economic policies.

APPENDIX 6A.–ADDITIONAL ANALYSIS OF THE SATELLITE COMMUNICATIONS SERVICE INDUSTRY

Demand for International Satellite Communications: Factors Influencing Its Growth and Scenarios for the 1990s

Policy Issues and Demand

As the discussion in chapter **6** has demonstrated, the future growth of satellite communications is a key parameter that will affect virtually all important U.S. international space and telecommunications policy issues during the remainder of this century. While the impacts of high or low demand for satellite communications services are reasonably clear, our ability to forecast what demand will be is limited. This is because satellite communications demand is not only the result of overall economic activity and the price of the satellite services, difficult in themselves to predict, but is also strongly affected by the availability and the price of closely substitutable terrestrial communications modes. Most important of all, the demand for satellite communications is tremendously affected by the institutional and regulatory structures governing both cables and satellites.

This section discusses in detail the factors influencing the demand for international satellite communications and shows how different scenarios for its growth can be the result of different outcomes for these factors.1

Demand for International Telecommunications as a Whole

Historically, U.S. international telecommunications has grown at an impressive rate. During the 1972-84 period, U.S. carriers' international real revenues grew at an annual average rate of approximately 13 percent (see table **6-l). Growth between 1980 and 1983 was temporarily slowed by recessionary conditions, but even during this period,** when other sectors of world trade experienced declines, real U.S. international telecommunications revenues grew at rates of about 8 percent per annum (except in 1982, when large cuts in AT&T's international telephone rates reduced revenues more than they stimulated demand).

Estimates of the future growth of international telecommunications are available from several sources. For 1985, the Department of Commerce projects a growth rate of 14 percent. U.S. telecommunications carriers also expect rapid growth of international communications to continue. In November 1984 forecasts prepared for a working group meeting in connection with the North Atlantic Consultative Process, the U.S. international service carriers (USISC)Z projected the demand for U.S.-Europe common carrier communications (including new services) to increase at an average annual rate of 16.3 percent during the period 1985-95. They foresee demand for telecommunications capacity of 82,000 voice-equivalent circuits in 1995 (table 6A-1, last line).J

[1] A similar treatment of the demand for U.S. domestic communications is beyond the scope of this assessment, but it is treated in less detail in ch. 6 and app. 66, in connection with the NASA ACTS program and with satellite communications equipment issues.

ZIn 1983, the major U.S. companies involved in the planning process were AT&T, RCA, Western Union, GTE, MCI, and ITT and COMSAT.

[3] This growth rate refers to the forecast of November 1984. Table 6A-1 also presents 1983 forecasts (which forecasted a significantly higher growth rate of 17.5 percent) by carrier and by major destination country. The U.S. carriers' European counterparts did not expect as rapid growth in overall transatlantic telecommunications demand in 1983 as did the U.S. carriers, Both

Table 6A-1 .—U.S..Europe Telecommunications Forecasts, 1985"95[a] (equivalent voice quality circuits)

	1985	1990	1995
Major traditional carriers:			
United Kingdom:			
AT&T	5,689	12,158	24,782
ITT Worldcom	289	501	775
MC1/WUI	299[b]	484	743
Western Union	15	143	631
RCA Globcom	229	354	479
Total above	6,521	13,640	27,410
Germany:			
AT&T	2,358	5,458	11,400
ITT Worldcom	82	129	179
MC1/WUI	61[b]	76	94
Western Union	5	49	206
RCA Globcom	67	92	117
Total above	2,573	5,804	11,996
France:			
AT&T	1,780	4,774	10,922
ITT Worldcom	48	80	130
MC1/WUI	49b	66	85
Western Union	4	34	154
RCA Globcom	35	53	73
Total above	1,916	5,007	11,364
Other CEPT countries	6,157[b]	13,481	30,670
New services n.e.c.	834[b]	1,766	4,326
Total traditional major carriers	18,001	39,698	85,766
Other U.S. carriers:			
GTE Sprint	356	2,777	7,673
Minor carriers	1,143	2,625	4,761
Total CEPTcountries[d]	***19,50@***	***45,100***	***98,200***
AT&T share	83.5%	81.9Y0	82.4%
IRevised forecast Nov. 1984]	18,092	37,161	81,888

[a]"Europe" here is the European Conference for Post and Telecommunications (CEPT) member countries: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and Yugoslavia.
[b]MCI estimates for 1986 are included in the 1985 totals.
[c]United Brands (TRT Telecommunications subsidiary), McDonnell Douglas (FTC Communications subsidiary) and GTE (Hawaiian Telephone Co. subsidiary), Estimates for total circuit demand, including estimates for these carriers, were provided to the FCC by AT&T and were constructed by adding up the estimates of the major carriers (including GTE Sprint) and adding to them an estimate for these carriers. The estimate given in this table for these carriers was calculated by subtracting the individual carriers' estimates from the AT&T overall industry estimate.
[d]The total estimate includes an unknown error due to differing assumptions on market shares the carriers used in constructing the forecasts. For instance, FCC analysts believe that AT&T's forecast for itself of 77.7 thousand circuits in 1995 is not based on an assumption that GTE Sprint would have anywhere near the 7,700 circuits that GTE Sprint forecasts for itself and that therefore the total forecast is somewhat too high due to double counting,

SOURCE: Communications to the Federal Communications Commission in August and September 1983 by the listed carriers, except the revised forecast, which is from the Report of the North Atlantic Consultative Working Group to the CEPT/USA/Teleglobe Canada Senior Level Meeting, Jan. 8-11, 1985, p. 24.

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(footnote continued)

groups revised their forecasts in November 1984, and the revised forecasts are relatively close. See table 6A-3 for the European carriers' forecasts. Carrier forecasts are also incorporated in the INTELSAT Traffic Data Base; see below note 11.

This rapid growth is expected in **all sectors except TV transmission by satellite. COMSAT'S 1983 forecast projects total half-channel hours of occasional-use tele**vision to increase from **2,180** in 1985 to 2,240 in 1995, and the number of 40-MHz transponders for full-period television to increase from three in 1985 to four in 1995. In both cases, this is less than a 3 percent annual growth rate.[4]

The U.S. international service carriers forecast that "new services, " including videoconferencing, facsimile, electronic mail, and computer traffic, while growing rapidly from a small base, will account for onlys percent of total demand by 1995 (table 6A-1).5 That new services will be a small fraction of total demand is in considerable dispute. A 1980 NASA study, for instance, projects very large worldwide videoconferencing demand in the 1990s, Videoconferencing alone is forecasted to constitute approximately one-third of total world telecommunications demand in the year 2000.[6] Several of the recent applicants for permission to construct transatlantic satellite and cable facilities have also stated in their applications to the Federal Communications Commission (FCC) that they expect videoconferencing demand to be substantial but have not given quantitative estimates of the growth; RCA in its application, for instance, stated that "teleconferencing should increase dramatically."

The Supply of Capacity in International Communications

Despite rapidly expanding demand, the discussion of facilities planning at the FCC has been concerned with excess capacity, rather than shortage.[7] Some ex-

[4]These numbers do not refer to videoconferencing, which is included in new services.

[5]AT&T, the principal contributor to the USISC forecast, nevertheless, intends to participate fully in any expanding market for videoconferencing that materializes, It recently introduced a U.S.-U .K. videoconferencing tariff. It has also signed an agreement with the French PTT to prowde transatlantic videoconferencing for multinational firms, using a system of INTELSAT satellites for transatlantic transmission and Telecom 1 for European transmission (*Satellite* News, Oct. 15, 1984, p. 4). And it has now introduced a new domestic C-band satellite videoconferencing service named Skynet Digital Service (Ibid., Oct. 22, 1984, p. 8).

[6]Future Systems, Inc., "Cross-Impact of Foreign Satellite Communications on NASA's 30/20 GHz Program," NASA Lewis Research Center, August 1980, FSI Report No. 251, It contains a detailed world satellite communications demand forecast, by type of service, pp. 24-85, Including extensive quantitative demand estimates for videoconferencing. Since the authors give a detailed analysis only for satellite transmission, it required minor calculation to relate their videoconferencing projection to total telecommunications demand. (To make these calculations, we used their assumption that 5 to 8 percent of nonvideoconferencing long-distance demand will be carried on satellites in North America, Europe, and Japan (higher in other world regions.) Future Systems, Inc., ibid., table 3-25, p. 60.

[7]For instance, see Federal Communications Commission, "Notice of Proposed Rule Making, " released Nov. 7, 1980, in CC Docket No. 79-184, "Inquiry Into the Policies To Be Followed in the Authorization of Common Carrier Facilities To Meet North Atlantic Telecommunications Needs During the 1985-1995 Period, "

cess capacity is, of course, required to maintain service quality in the event of a facilities outage[8] and to guard against greater-than-expected demand on the system. When capacity is added in large increments every few years, such as in the TAT-8 and TRANSPAC-3 transoceanic cables or in INTELSAT VI facilities, excess capacity in the early years is inevitable if shortages are to be avoided before the next capacity addition. But other reasons relating to the industry structure of regulated industries, which we discuss below, may also be involved.

As part of the FCC's formal facilities planning process, various facilities plans have been proposed' by communications carriers or groups of carriers to meet projected transatlantic telecommunications demand. Table 6A-2 lists the plans proposed in 1980 by the U.S. international service carriers as a group (USISC), plus **COMSAT,** as well as a reference plan the **FCC con**structed for analytical purposes to determine when capacity would equal demand. Some of the features of these three plans are:

- They differ principally in when they schedule the transatlantic cables.
- They cover a range from 106,000 to 145,000 U. S.-Europe circuits in 1995.
- They do not include satellite or fiber optic cable capacity supplied by private U.S. or foreign communications firms.
- A single cable or large satellite, such as the TAT-9 cable (included in the USISC plan but not in the COMSAT or FCC plans), can by itself produce a large excess supply of capacity.

The amount of transatlantic cable capacity is potentially even more uncertain than indicated in the plans. Fiber optic technology is evolving rapidly and becoming more efficient in the sense that improved digital multiplication techniques are increasing the number of telephone circuits that can be carried on a given cable. Furthermore, large additional cable capacity can be provided in cables by straightforward design changes (e.g., three working fiber pairs rather than two). What is holding down the size of cables (particularly the USISC planned facilities) is not the limitations of the technology but the size of the demand and the regulatory policy requiring a balance between satellite and cable facilities. g

[8]Restoration of service of different given qualities after a faci lities outage requires different types of backup facilities. The new competition developing on the North Atlantic among carriers who may desire different qualities of restoration, the large size of the individual TAT-8 and INTELSAT VI facilities, and the new network management techniques that allow carriers to make optimal use of facilities, has made the discussion more complex in recent years. (U.S. International Service Carriers submission to the North Atlantic Consultative Working Group meeting, Jan. 31-Feb. 2, 1984, Pans, France, p. 29.)

[9]A case in point is that TAT-8 was originally designed by AT&T to have 12,000 basic circuits. With an assumed 3-to-1 multiplication factor, the cable was then rated as capable of carrying 36,000 simultaneous telephone conversations (or some lesser number of telephone, record, data, and video circuits, since the 3-to-1 multiplication factor does not apply to the latter types of service). It is now expected to have a 5-to-1 multiplication factor. (U.S. Carriers' submission to the North Atlantic Consultative Working Group meeting, Jan. 31 -Feb. 2, 1984, Paris, France, pp. 15-1 6.) To compensate for the improved performance of the cable—a 5-to-1 multiplication would re-

Table 6A-2.–Representative Transatlantic Facilities Plans for U.S.-Europe Telecommunications, 1985-95

	USISC[a] 1983 demand	USISC Plan 1		COMSAT Plan 1		FCC reference plan	
Year	Forecast	Type	Capacity[b]	Type	Capacity[b]	Type	Capacity[b]
1985 , ...	19.5		34.0		34.0		34.0
1986	23.0	1-VI PP	45.9	1-VI PP	45.9	I-VI PP	43.6
1987	27.1	1-VI	45.9	I-VI Spare	45.9	I-VI Spare	43.6
1988	33.0	TAT-8 I-VI MP1	81.2	TAT-8 I-VI MP1	81.2	I-VI MP1	49.4
1989	38.6	I-VI MP2	88.4	I-VI MP2	88.4	I-VI MP2	54,3
1990	45.1		88.4		88.4	54.3	
1991	52.6		88.4		88.4	TAT-8	81.1
1992	62.5	TAT-9	115.6		88.4	81.1	
1993	72.7	1-VI PP I-VI Spare	129.8	1-VI PP I-VI Spare	102.6	1-VI PP I-VI Spare	93.0
1994	84.5		129.8		102.6	93.0	
1995	98.2	I-VII MP1	145,1	I-VII MP1	117.9	I-VII MP1	106.0[c]

KEY: Fiber optic cables–TAT-8 and TAT-9
Satellites–INTELSAT VI Prtmary Path 1-VI PP
INTELSAT VI Primary Path Spare I-VI Spare
INTELSAT VI Major Path 1 I-VI MP1
INTELSAT VI Major Path 2 I-VI MP2
INTELSAT Vll Major Path 1 I-VII MP1
Satellite designs identical except for FCC satellites, which are lower capacity L designs.

[a]USISC = U.S. International Service Carriers The principal ones are listed in table 6A-1.
[b]Thousands of voice grade circuits.
[c]The FCC reference plan eliminated excess capacity in 1995 when compared with the then-current 104,516-circuit USISC 1995 forecast.

SOURCE: Demand forecast: 1963 forecast from table 6-Al. Facilities: Federal Communications Commission, "Notice of Proposed Rule Making," released Nov. 7, 1960, in CC Docket No. 79-164, "Inquiry into the Policies to be Followed in the Authorization of Common Carrier Facilities to Meet North Atlantic Telecommunications Needs During the 1985-1995 Period," pp. 20-35.

By early 1985, the FCC had received applications to install satellite capacity of about 120,000 circuits and fiber optic cable capacity of about 330,000 circuits for transatlantic communications, in addition to the capacity additions listed in table 6A-2.[10] These large proposed capacity additions call into question the FCC planning process, the demand projections of the USISC carriers and their European counterparts or both.

Satellite Communications' Share

European communications carriers (CEPT) expect that satellites will maintain their share of transatlantic telecommunications at least through 1995, according to projections submitted in connection with the North Atlantic Consultative Process (table 6-A3).[11] In all years, and for AT&T and other U.S. carriers independently, the CEPT forecast has the satellite share remaining at over 50 percent.

suit in a capacity of 60,000 circuits—the originally contemplated three-fiber-pair cable was replaced by a two-fiber-pair cable (ibid., p. 12) with only 8,000 basic circuits, which would have a capacity of approximately 40,000 circuits. These data indicate that capacity estimates for the transatlantic cables may be alterable by design changes, by improved multiplication techniques, and by Investment in multiplication equipment embodying these techniques.

[10] See also the discussion of alternative satellite providers in ch. 6. The additional 330,000 circuits of cable capacity are in the cable projects of Cable & Wireless and its U.S. partners (TelOptic) (license granted) and Submarine Lightwave Cable Co. (license recommended by the FCC), of 80,000 and 250,000 circuits, respectively.

[11] The USISC forecasts for circuit demand presented to the North Atlantic Consultative Process (table 6A- I above) are not broken down by the shares for satellites and cables. Data submitted to the INTELSAT Traffic Data Base, which Includes a U.S. submission based on data from U.S. carriers, however, is roughly consistent with the CEPT forecast. For instance, satellites are projected to have 1995 demand for 11,312 4khz-equivalent satellite circuits between the United States and the United Kingdom. (INTELSAT, Contribution of the Director General BG-56-1OE W/9/83, Aug. 2, 1983.) Although not strictly comparable this may be compared to the major USISC carriers' U.S.-U.K. projection in table 6-3 of 27,410 circuits to get a rough idea of the satellite share.

Table 6A.3.—Satellite Share of International Communications Capacity CEPT Master Plan Projections[a]

	1986	1990	1995
		(circuits)	
AT&T-CEPT	18,023	33,086	67,533
'/0 satellite	52.2Y0	56.O?AO	54.7?40
Other USISC carriers-CEPT	2,338	3,465	5,241
'/0 satellite	57.7'?/0	57.7%0	59.OYO
Total USA-CEPT	20,362	36,543	72,766
'/0 satellite	52.80/o	56.1 0/0	55.00/0
AT8LT share of total demand	88.50/o	90.50/0	92.80/o
[Revised forecast Nov. 1984]	20,829	38,329	83,640

[a] "Europe" is defined here as the European Conference for Post and Telecommunications (CEPT).
[b] Circuit Projecting include "new services" and are broken down by individual years, facilities and European countries in the source document.

SOURCE: Conference Europeen des Administrations des Poste et des Telecommunications (CEPT), "CEPT Master Plan, Transatlantic Facilities Requirements, 1988-1995," January 1984, except the revised forecast, which is from the Report of the North Atlantic Consultative Working Group to the CEPT/USA/Teleglobe Canada Senior Level Meeting, Jan, B-1 1, 1985, p. 24.

DEMAND FOR INTERNATIONAL SATELLITE COMMUNICATIONS IN THE 1980s

The demand for international satellite communications can be expected to continue to grow rapidly in the 1980s, because major capacity on the expected competing transmission mode, fiber optic undersea cables, will not be in place until 1988, when the TAT-8 cable is scheduled to be operational. Other cable landing applications, which have been filed with the FCC, are for cables to be constructed in the 1988-92 period, as well.

DEMAND FOR INTERNATIONAL SATELLITE COMMUNICATIONS IN THE 1990s

Whether international satellite communications will continue to grow as rapidly in the 1990s as international communications as a whole is highly uncertain, however, and will depend on the following factors:

- The price advantage/market preference, if any, of fiber optic over satellite transmission for high-volume applications.
- The strength of industry-structure and other incentives to the adoption of fiber optic technology.
- The growth of undersea cable capacity and the presence or absence of regulatory restrictions on its use.

Discussion of Uncertainties in Factors Affecting the Demand for Satellite Communications

EXTENT OF PRICE ADVANTAGE OF OR CONSUMER PREFERENCE FOR FIBER OPTIC UNDERSEA CABLES

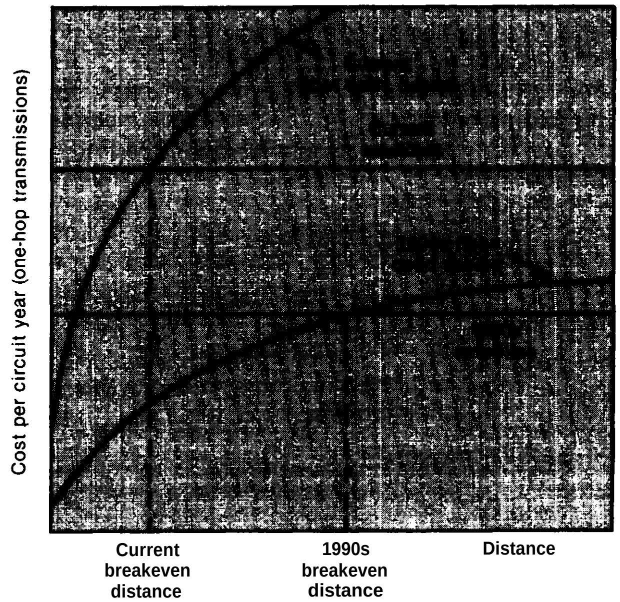
Any basic advantage that fiber optic cable technology will have over satellite technology for use in **U.S.** long-distance international communications in the 1990s will probably depend more on technical features than on cost,[12] because the difference in cost

[12] By "cost," we refer to the investment cost of the communications and maintenance facilities and the cost of operating them, per unit of communications. Since the investment cost is the most important cost component, cost estimates are sensitive to the depreciation periods assumed for cables and satellites and to the discount factor used in calculating present values. An economic evaluation of cost will usually be different from an accounting evaluation and both cost concepts should be distinguished from price. Both average and marginal cost concepts are used in the discussion.

is not likely to be large for long-distance communications, such as transatlantic or transpacific communications. In any case, the prices charged users of the alternative satellite and cable facilities may not bear a close relation to cost.

Cost.–Not long ago it seemed that advanced satellites would have a large cost advantage over fiber optic cables.[13] Rapid advances in fiber optic technology have now convinced many experts that fiber op,-tic cables will eventually be less costly than satellites over substantial distances.[14] At very long distances however, satellites are expected to retain some cost advantage because transmission cost by satellite is nearly invariant with distance, while transmission cost by cable is not.[15] Figure 6A-1 is a conceptual diagram that illustrates how these characteristics result in a breakeven point that may affect the choice of mode in international communications investment. Technological forecasting, difficult enough for all technologies, is especially difficult in telecommunications due to the rapidity of fundamental change and the flow of innovations. Nevertheless, in OTA'S judgment, fiber optic technology will probably experience greater cost reduction than satellite technology. This judgment is based on the premise that satellite technology is now more mature than fiber optic technology and that considerable "learning economies" are still available for the latter.[16] Both technologies have further room for fundamental innovation, and substantial R&D is being done in both. However, because light wave-guide technology is farther below its theoretical information capacity limit than microwave transmission from satellites, and because the latter is constrained by practical interference problems, fiber optics appear to have the better chance of experiencing innovations that would significantly reduce costs. Thus, while the breakeven distance in the 1990s should be regarded as highly uncertain, it is likely to increase.

Figure 6A-1.—Cost of Satellite vs. Cable Transmission (Addressable Communications): Conceptual Diagram



The horizontal lines for satellites indicate that average satellite transmission cost per circuit-year does not vary by distance for current and future generation models and that future cost is lower than current cost. The rising curved lines for fiber optic cables indicate that average cost for both current and future generation technology does vary with distance, but that the cost increase per mile declines as distance increases.

NOTE: Diagram is constructed to illustrate the situation where breakeven distance increases markedly for 1990's technology.

One further important aspect of the technological competition between cables and satellites in long-distance international communications is also illustrated in the diagram. For the long distances typical of transatlantic and transpacific communications and of communications to and from South America, satellites and cables may not differ very much in transmission cost, even if satellites are less costly than cables.[17] This is because, while the transmission cost for cables will increase with distance, it will not increase

[13] For instance, see Future Systems, Inc., "Transmission Cost Comparison for Satellite, Fiber Optics, and Microwave Radio Communications," FSI Report No. 107, Gaithersburg, MD, May 1980. Since facilities cost is most of the cost of transmission, the cost concept referred to is long-run average cost.

[14] Industry sources surveyed by telephone in 1984 estimated that the breakeven distance will be in the 800 to 1,000-mile range in the late 1980s. It is expected to increase in the 1990s.

[15] All current commercial satellite transmissions travel roughly 44,600 miles roundtrip to the geostationary orbit and back, regardless of the terrestrial distance between the sending and receiving points. The transmission cost is thus the same regardless of distance (for one-hop transmissions). Conversely, since longer cables cost more to lay than shorter ones, cable transmission cost varies with distance. Two-hop satellite transmission is approximately twice as costly as one-hop transmission, it should be noted, however.

[16] See, e.g., J. Shubert, "Progress in Optical Communication Technology, " *Telecommunications,* July 1983, Global Edition, vol. 17, No. 7, p. 35-1. In a 1984 press report, AT&T Bell Laboratories announced the development of an improved fiber over which signals can be transmitted with 10 times as much strength after 125 miles, without boosting, as any previous fiber, a feature important for undersea cables (New *York Times,* 1984). NASA believes that zero-gravity, containerless manufacturing of very pure glass in space may increase fiber optic efficiency. (*Space Enterprise Today,* September 1984, p. 5.)

[17] Below the breakeven distance, fiber optic cables are expected to have a substantial cost advantage. Within the United States, therefore, it is likely that carriers will use fiber optic cables for dense trunk routes. At a 1984 conference on satellites v. fiber optic cables, the president of IBM's subsidiary, Satellite Business Systems, stated that even SBS plans to develop a fiber optic network for high-traffic trunk routes to complement its current primarily satellite network, because [within the United States] "it is highly efficient for point-to-point trunking" ("Fiber Optics, Satellite Technologies Confront Each Other: Merging Expected, " *Satellite News, Nov.* 19, 1984, p. 8).

proportionally for longer cables.[18] Thus, even at distances far above the breakeven point, satellites may not have much of an advantage in transmission cost. Considering that nontransmission costs do not differ by mode, this advantage would be even less as a proportion of total message cost.

Price.–The implicit implication of many discussions of the relative cost of cables and satellites is that telecommunications service markets will react to cost differentials in much the same way they would react to price differentials. This is clearly not the case in international telecommunications. In some industries, cost can be used as a proxy for price, because price and cost are of similar magnitude in these industries. In international telecommunications, however, there can be very wide divergence between cost and price.

This is not to say that cost competition between satellites and cables is not an important long-run factor i n determining the supply of various kinds of i nternational telecommunications facilities, since if cost differentials are large, they would affect carrier incentives to invest in various types of capacity. But in the telecommunications service markets themselves, it is *prices* that buyers pay, and to which they react, not the costs of suppliers.

The significance of this is twofold: 1) even if costs differ for satellites and cables, the prices could and would probably be closely similar and 2) under conditions of overcapacity, international telecommunications prices could drop far below calculated full costs, as carriers responded to market pressures,

Prices would be similar for telecommunications services using the two transmission media (if markets were unrestricted) because they deliver similar services, This would occur regardless of what the facilities cost to install when they were new or what new facilities would cost. If prices started to diverge, consumers would move toward the cheaper medium, and sellers of the expensive one would have to lower their prices to stay competitive.

International telecommunications prices (similar for both media) could also drop far below the full costs of both satellites and cables. Telecommunications service markets contrast with many other markets in this regard because of one key factor; the telecommunications service industry (using either satellites or cables) is highly capital intensive. Capital intensity means that most costs are incurred when the facilities are installed and that variable costs for labor, materials, power, etc. are small relative to total cost. Because of this, revenues from the sale of services are usually used mainly to cover payments of principal and interest on debt incurred in acquiring the facilities, rather than for meeting payrolls and paying suppliers.

If the market becomes highly price-competitive because of excess capacity, carriers may have to reduce their prices markedly to sell anything at all. The paradoxical aspect of this is that even if overcapacity should cause prices to drop to very low levels, individual carriers would not have an incentive to reduce the capacity offered for sale and thereby counteract the overcapacity. In fact, the prime motivation for dropping prices would be to keep capacity in operation and earn as much cash flow as possible, for even at very low prices, carriers would still generate cash flow as long as they covered the low variable cash costs of running the operation. If they tried to charge higher prices to cover full costs, there would be few or no sales, little or no revenue and thus little if any cash flow from operations. For these twin reasons, the existence of net revenue possibilities even at low prices and the inability to sell much except at the competitive price, individual firms have a strong incentive to keep the facilities in operation.

Even bankruptcy would not serve to inspire them to remove the facilities from service. If a court gives protection from creditors, the firm could continue to use the net cash flow from operating the facilities to make partial payments to creditors and for other uses. If the assets had to be sold at realistic prices consistent with the reduced earning potential of the facilities, the new owners would also have incentives to operate them. These would be the usual investment incentives of cash flow and profits. Thus, while very low prices might constitute a severe financial problem for carriers with high fixed obligations, their financial problems would be unlikely to induce them to take their capacity off the market.

Overcapacity does not last forever, however. It is a so-called “short-run” phenomenon, in the sense that in normal competitive markets, it would ultimately be worked away as plans for new investment are reduced and existing equipment depreciates. Yet in telecommunications, overcapacity, with low prices could persist for many years. The low prices that have persisted for years in the markets for certain long-lived capital items (and for the services rendered by them) —e.g., supertankers and widebody jets—are instructive on this point.[19]

[18] These economies to scale are Illustrated in fig. 6A-1 by the curvature of the cable cost curve.

[19] Although this discussion concentrates on overcapacity, shortages of international telecommunications capacity could also occur and result in prices considerably higher than costs.

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In a situation of overcapacity, the gradual working off of surplus capacity and the restoration of prices that cover full costs, of course, assumes a relatively normal investment market. Such a market exists in U.S. domestic satellite communications. In a situation of overcapacity, sources of financial capital become less willing to invest in more capacity. An adjustment process then takes place. Rapidly expanding demand or rapid physical deterioration of the capacity speeds this adjustment process. In the case of international satellite communications, however, the investment market is far from normal, Governmental, intergovernmental and regulated institutions—INTELSAT and its mostly PTT owners are currently the principal investors in international satellite facilities—may not respond to market signals as quickly as private firms might,

Much of this analysis applies to carriers making decisions singly. If carriers should make coordinated decisions on prices (in many circumstances illegal under the antitrust laws) or if governments should impose capacity-use regulation on the industry, capacity could be withdrawn from the market, and prices could be higher. Even in this circumstance, however, if consumers responded to low prices by substantially increasing their purchases, prices designed to maximize carrier net revenues would still probably be way below full cost.

One further aspect of capacity in international communications should be considered. Since all satellites have on-board propulsion capabilities that allow them to be moved occasionally from one world region to another, the locations of particular satellites and, therefore, of excess satellite capacity, will also respond to market forces.[21] At present, there is a regulation-enforced separation between domestic and international facilities, but if private satellite firms from the United States and other countries are allowed to enter international facilities markets, domestic and international capacity may ultimately become interchangeable, and world overcapacity (or shortage) would affect both international and domestic prices.

[20] It should not be concluded, however, that govern mental entities operating in substantially competitive international markets will not make rational commercial decisions. Evidence from the international airline industry in the period 1976-80 indicates that European state-owned carriers had approximately the same rates of return as U.S. private carriers and that, in response to changes in demand, they adjusted capacity similarly in individual North Atlantic city-pair routes (Douglas L. Adkins, Martha J. Langelan, and Joseph M. Trojanowski, "IS Competition Workable in North Atlantic Airline Markets?" Civil Aeronautics Board, March 1982).

[21] Because of limited on-board propulsion fuel, changing orbital position can only be done infrequently as a practical matter. If permitted by regulation, satellites would be sufficiently mobile, however, to allow transponder sale and lease prices to be determined by world rather than national conditions of supply and demand, just as the prices of super tankers or wide-body jets now are.

Technical Features.–Fiber optic cables appear to have three technical advantages over satellite transponders that are moderately to highly important in certain applications in international communications—freedom from external and environmental sources of interference, greater communication security, and relatively short signal delay. None of these advantages is decisive in volume uses of international telecommunications, however.

For instance, despite the greater vulnerability to interference, error rates for satellite communications can be designed to the same minimum technical specifications in most cases as fiber optic cable systems, but the extra design features can be costly.

The greater signal delay in satellite transmission adds to the total of all the delays in terrestrial switching and in the facilities through which it must pass and, thus, typically consumes between one-fourth and one-third of a second. innovations in satellite transmission of ordinary voice and videoconferencing are likely to continue to improve the techniques that now reduce the disadvantages of satellites that arise from signal delay in those uses and in interactive data transmission as well.

In communication security, the absence of an electromagnetic field around a fiber optic cable means that, to intercept the information, the cable itself has to be tapped, an act that can be detected by sensitive monitoring devices. In contrast, microwave radiation that satellites use to transmit information is usually easily accessible by the public and certainly by those who would intercept it. Encryption possibilities, however, can give satellite microwave transmission substantial protection against all but the most sophisticated interception attempts. Once again, there may bean extra cost penalty for various levels of security for satellite v. fiber optic transmission.

Taken together, the disadvantages of satellite transmission result in a product that is currently perceived by users to be somewhat technically inferior to the product of cable in certain point-to-point applications, particularly voice, certain computer applications, and secure communications. If there should be carriers who specialize in a single mode of transmission, as several of the new firms applying for permission to construct satellite or cable facilities are planning to do, or if carriers using both modes should offer consumers the opportunity to choose mode, the preferences of the marketplace would govern. What seems a trivial disadvantage to satellite proponents might loom large in consumer choices.[22]

[22] Speakers at the Fourth Annual Satellite Communications Conference, Washington DC, Apr. 10-11, 1984, who were involved in satellite communications as producers or consultants uniformly stated that when the echo

When there are domestic communications legs on either side of the international leg, undersea cables may sometimes have an advantage over satellites in international transmission. Because of the total delay, CCITT recommendations and consumer preferences discourage the use of more than one satellite hop in end-to-end service. Mixed satellite/cable transmission is the means employed to keep the satellite segment to one-hop, of course. In international communications, this may result in a preference for cable transmission in certain situations. If domestic transmission by satellite has been decided on for the U.S. leg, for instance, because a business user would like to bypass the local phone company, keeping the satellite link to one-hop would induce such a user (or his carrier) to arrange cable transmission for the international link. If the domestic link was cable, however, there would be no parallel incentive to use a satellite for the international link.

International satellite transmission currently has two important advantages over cable transmission—broadband capability and certain networking advantages. Broadband capability refers to the ability to send large amounts of related information simultaneously and is important i n television and certain data applications. Large capacity coaxial copper cables, terrestrial microwave, and fiber optic cables all have this capability, as do satellite transponders, but for the broadband communication to take place, the capability must be in place end to end, This is straightforward for most all-satellite systems, but for terrestrial networks, all legs and switching facilities must have broadband capability. Currently, it is often necessary to have a satellite link in order to have broadband communication at all. As international and domestic fiber optic networks become widespread in the 1990s, this advantage of satellites will diminish and will probably not continue to be quantitatively very important.

Satellites have a more enduring advantage in certain networking applications. For instance, point-to-multi point transmissions are trivially simple using a satellite. The single transmission can simply be picked up by even thousands of individual satellite Earth stations. To do the same thing in cable networks would require vast amounts of switching, something which would not usually be done terrestrially if the number of destinations were at all large. In general, whenever the alternative terrestrial network becomes cumbersome or expensive or lacking in certain capabilities, satellites can be employed to bypass the difficulties and transmit directly from one Earth station to another.

These special networking capabilities of satellites will ensure a market for communication satellites. Only if nationwide and worldwide fiber optic networks should have large excess capacity in the future would they be used for the point-to-multipoint (or multipoint-to-multipoint) communications that satellites have a cost natural advantage in. Nevertheless, this advantage is important in only a small proportion of the international communications volume sent by satellites at present. It is likely to grow rapidly if international videoconferencing does, but will become a large fraction of international satellite communications only if satellites lose out to fiber optic cables in the telephone, record, and data uses that now constitute the major uses of international satellite transmission.

Industry-Structure Incentives to Adoption of Fiber Optic Technology

The second important uncertainty affecting the demand for international satellite communications in the 1990s is whether the structure of the communications industry will continue to provide incentives to invest in and use cable technology that are independent of the cost and technical features of fiber optic cables. Three such incentives have been suggested in analyses of telecommunications industry structure .[23]

First, U.S. regulated international telecommunications carriers are said to have a bias in favor of investment in undersea cables that they own and which therefore constitute part of their rate base, in preference to the alternative of leasing INTELSAT/COMSAT satellite transponders, which are not in their rate bases. This incentive (to buy cable capacity rather than lease capacity on satellites) allegedly operated in the past even when transatlantic transmission by satellite had a substantial underlying cost advantage over coaxial copper cable. It and other reasons have been cited to explain why the FCC ordered the balanced use of satellite and cable capacity in transatlantic service.

The putative industry bias toward investment in cables, which has existed during the period when cable technology had a cost disadvantage, would undoubtedly reinforce any desire of the carriers to use cable technology for other reasons. It might be mitigated if the carriers should come to own satellite facilities. RCA, for instance, has proposed to use a satellite for transatlantic communications that it had

equipment was tuned properly, the delay problem for one-hop satellite transmission was trivial. On the other hand, representatives of a large bank and a large developer stated that there is currently a prejudice among consumers against satellite transmission on the basis of quality.

[23] See, e.g., Bruce M. Owen and Ronald Braeutigam, *The Regulation Game* (Cambridge, MA: Ballinger, 1978), ch. 2-"Regulatton of Oligopoly: International Communication;" and Michael E. Kinsley, *Outer Space and Inner Sanctums: Government, Business and Satellite Communication* (New York: Wiley, 1976).

originally proposed solely for domestic use. It would, of course, be able to include this satellite in its rate base.[24]

It should be noted that the preference for facilities that can be put in the rate base is a long-run decision factor in the purchase of facilities, with the comparison being between installing new cable capacity in preference to an alternate program of leasing satellite capacity during the life of the cable. Besides this long-run factor, there is also a powerful short-run incentive for U.S. international service carriers to use cables. Once a cable and associated maintenance capability is owned but not fully utilized, the variable cost of using it approaches zero and is, of course, much smaller than COMSAT'S circuit lease price.[25] This powerful incentive to use owned cable facilities up to their capacity before leasing more expensive INTELSAT/COMSAT satellite capacity operates strongly during the early life of a new cable facility before it approaches capacity use. if carriers owned under-utilized satellites as well as cable facilities, this incentive would also cease to operate.

Finally, some carriers, such as AT&T, KDD, and Cable & Wireless, are also producers and servicers of cables; they may favor using what they themselves manufacture and maintain. Carriers manufacturing satellites, such as RCA, might find a similar reason to favor satellites.

Some of the major European PTTs are also said to favor using cable facilities over satellites for much the same reasons as U.S. carriers.[26] The incentive to use unused cable capacity before INTELSAT probably also applies to them as well as to the U.S. private carriers, but because of the different regulatory structure, the impact is less powerful. In the first place, they pay the lower INTELSAT utilization charge rather the higher tariff of an intermediary such as COMSAT. Secondly, as signatories, they make investment payments and receive returns on that investment that vary with their usage of the INTELSAT system. Nevertheless, the variable cost to most PTTs of increased INTELSAT use is probably greater than the variable cost of cable use.[27] They would not have the same incentive to create excess cable capacity as U.S. carriers, however, unless they were also subject to regulation similar to U.S. return-on-rate-base regulation.[28]

CABLE CAPACITY GROWTH

The third key uncertainty that will affect the demand for satellite communications in the 1990s is the growth of usable undersea cable capacity vis-a-vis the demand for telecommunications service.

Transoceanic cables often require lengthy periods between conception and installation for planning, regulatory action, and construction. The official planning process for a transpacific fiber optic cable, for instance, was only just beginning in 1984 (following extensive planning work by individual carriers), and it is possible that the TRANSPAC-3 cable will be delayed beyond its proposed year-end 1988 service date.[29] Considering the TAT-8 transatlantic cable and the other proposed transatlantic cables, 5 years or more could be regarded as the norm.

If telecommunications demand should outstrip the cable capacity available in a geographical sector for any reason, satellites, if available, could and would be repositioned to serve it. More rapid growth in demand than expected, or regulatory restrictions on cable installation, could be important reasons why total telecommunications demand might outstrip cable capacity.

If, on the other hand, there should be excess cable capacity (the more likely case in the Atlantic region), the question remains as to whether it would be used in preference to satellite capacity. It would appear, according to the discussion above, that U.S. international carriers have a significant incentive to invest in and use their own transatlantic facilities (which happen to be cables because of the industry structure imposed by regulation) rather than facilities owned by other entities (which happen to be satellites). By 1985

[24] In fact the incentive could shift in favor of owning satellites if satellite capacity were relatively inexpensive due to glut conditions, such as now may be occurring in U.S. domestic communications. A 1984 survey by the FCC found that there only 143 out of 312 transponders were in use on 14 satellites on a weekday afternoon. ("Satellites Outpace Customers," *New York Times*, Apr. 10, 1984, First Business Page.)

[25] The Variable transmission cost of using the cables they own is primarily the cost of the electrical current and of the cable repairs, and this is relatively small compared to the fixed cost of building the cable, providing it with auxiliary communications equipment, and providing maintenance vessels and facilities. In the case of underutilized INTELSAT satellite facilities, however, the variable cost to AT&T, for instance, is still the COMSAT tariff. This tariff Includes a capital recovery factor and is thus considerably higher than the small variable satellite transmission cost. COMSAT's prices for satellite circuits may also have been higher than they need be, due to a higher than normal rate of return and the existence of substanital INTELSAT excess capacity which the FCC allows COMSAT to earn a rate of return on.

[26] Bruce M. Owen and Ronald Braeutigam, op. Cit., p. 61.

[27] For PTTs subject to significant transit charges, however, cable variable costs may be significant, and their incentive to use cables would be less or nonexistent.

[28] It should be noted that a PTT's bias in favor of using fiber optic cables for communication trunks does not necessarily mean that they can handle large volume and/or broadband communications in their local cable networks, Until appropriate switching and broadband transmission facilities have been installed at the local exchange level, premises-to-premises satellite transmission may be the only practical way to handle business communications that that require these facilities.

[29] According to a AT&T press release, Jan. 23, 1985, Hawaii 4/TRANSpAC-3 will have two working fiber pairs, will run 7,200 nautical miles across the Pacific, will have approximately 250 undersea generators, and would be able to transmit 37,4oO simultaneous telephone conversations,

the FCC had granted or recommended cable landing licenses for fiber optic capacity of approximately **370,000 voice** circuits to be installed in 1988 or 1989, compared to the 1990 USISC forecast (above, table 6A-1 of 45,000 equivalent voice circuits.[30]

Hence, unless regulation or other nonmarket forces impell carriers to use satellites in a situation of plentiful carrier-owned cable facilities or unless carriers come to own satellites, they would be likely to use available cable facilities in preference to satellites, even if, to a certain extent, satellites were less expensive.

Scenarios for Growth of Satellite Communications Demand in the 1990s

Depending on what assumptions are used for the uncertain factors that we have just discussed, projections of the demand for international satellite communications would vary. Since all of the factors are highly uncertain, the discussion is organized into three credible scenarios that use different assumptions that result in rapidly growing demand, slow growing demand and plateauing demand, respectively.

SCENARIO 1: RAPID GROWTH OF SATELLITE COMMUNICATIONS IN THE 1990s

The North Atlantic communications carriers, both the U.S. international service carriers and the European CEPT carriers, expect Scenario I–continued rapid growth of satellite communications—at least through 1995, as indicated by the projections provided for the North Atlantic Consultative Process. These projections were discussed above in this appendix and are presented in tables 6A-1 and 6A-3.[31]

Implicit in the carriers' facilities demand forecast for the North Atlantic are assumptions about a number of factors that would lead to rapid growth in satellite communications in the 1990s. This could result from fiber optic cables having little or no cost/price advantage or consumer preference, from the absence of special carrier incentives to use cable transmission, or from limited actual cable capacity in place or in use.

SCENARIOS II AND III: MODERATE OR ZERO GROWTH OF INTERNATIONAL SATELLITE COMMUNICATIONS IN THE 1990s

Four elements, none of them improbable, could cause a slowdown in satellite communications growth as a result of the substitution of fiber optic cable for satellite transmission. First, various decision makers could perceive fiber optic technology to be superior for reasons of its technical features or cost/price advantage. Second, the price (or other advantage) would be available to them in such a way that they would actually have the incentive to use cable transmission. Thirdly, actual cable capacity would be great enough to service most of the growth in total telecommunications demand. And last, but not least, there would be a noninhibiting U.S. and international regulatory framework that would allow greater relative cable use.

Scenario II **Slow Growth.–Even** if consumers or carriers came to prefer fiber optic cables for transatlantic and other long-distance international communications in the late 1980s, their preference might not be particularly intense. They therefore might not make the switch very rapidly. Whether or not their preference is intense, regulatory barriers in any case could delay the adoption of cable transmission. For all of these reasons, satellite usage in high-volume trunking applications might continue to grow, if only moderately, through the end of the century.

Scenario III: No-Growth Plateau.–In this scenario, cable transmission would be adopted relatively quickly because of strong carrier or consumer preference, or for other reasons, and would be used for most high-volume point-to-point international communications. Cable capacity for this expansion would be in place by the early 1990s in the form of the TAT-8, TAT-9, and TRANSPAC-3 cables to be constructed and owned by cable consortia and/or those proposed by individual firms. Satellites would still perform an essential role in long-haul international communications, however, particularly on low-volume routes to smaller or less developed countries and to remote areas. Satellites could also fill in where cables had not been constructed or could not handle broadband communications because of networking problems. Essentially, satellite transmission in this scenario would serve as the backup technology for cable transmission.

Satellites would also continue to be used where they have a competitive edge over cables in technical features or cost: to service the growing expected demands for point-to-m ultipoint or multi point-to-m ul-

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[30] This estimate includes 40,000 for the approved TAT-8 cable, and 80,000 and 250,000, respectively, for the proposed Cable & Wireless (TelOptic) and Submarine Lightwave Cable Co. cables, making a total of 370,000 voice-equivalent circuits. These estimates must be regarded as order of magnitude only, since estimates of multiplication factors for voice conversations are likely to change considerably.

[31] Data submitted to the INTELSAT Traffic Data Base reflecting the projections of the U.S. International service carriers tends to reinforce this expectation of rapidly growing transatlantic satellite communications demand through 1997. (I NTELSAT Contribution of the Director General, BG-56-1OE W/9/83, Aug 2, 1983.) See note 11.

tipoint communications, for certain mobile communications, and for broadband communications where local broadband fiber optic or microwave distribution capacity was not in place. This scenario posits a leveling off of satellite communications in the 1990s, **rather than a decrease. The latter would result if these specialized uses did not grow sufficiently to offset the relinquishment of high-volume, long-haul traffic to** cable[32]

The Regulatory Regime in International Satellite Communications[33]

The Traditional Regulatory Regime in U.S. International Telecommunications

Ten years ago, both the domestic and international segments of the U.S. telecommunications industry were tightly controlled by government regulation. Consumers of international telecommunications services were not allowed to choose among carriers on the basis of price and service offerings.[34] The carriers of the countries between which the communications moved were almost always organized into a monopoly or close-to-a-monopoly structure and thus did not have to respond closely to consumer needs.

On the U.S. side, as a rule, each country-pair market was segmented into a number of nearly air-tight compartments. There was a telephone ("voice") monopolist (usually AT&T). Terrestrial and satellite record (telegraph/telex) communications for the most part had to pass through a small, regulated cartel of U.S. "international record carriers, " principally ITT, RCA, and **WUI,[35] prior to being interconnected with Western Union**, the de facto monopoly domestic telex/telegraph company .36 On the foreign side, the operator of both voice and record facilities was usually a single government post, telephone, and telegraph firm or ministry (PTT). Usually, the PTT controlled virtually all civilian telecommunications—voice and record, satellite and terrestrial, international and domestic.

In cable transmission, the cartel arrangements were cemented further by joint ownership of oceanic cables. For private, regulated U.S. carriers, ownership in cables is counted among the assets of their rate bases. The size of a carrier's rate base, in turn, along with the allowed rate of return, determines the maximum allowable profit in regulated activities.

The situation has been somewhat different in satellite communications, principally because there are intermediaries (INTELSAT and COMSAT) whose tariffs must be paid. All U.S. intercontinental satellite communications are currently routed through COMSAT and INTELSAT. U.S. international service carriers pay COMSAT'S tariff, and COMSAT, in turn, pays INTELSAT ciruit charges.[37] This differs from the cable situation in that once the cable is in place, only minor payments are made by the owner-users for cable use and maintenance, and usage sensitive costs are practically nil.[38] In the satellite situation, carriers have to pay the COMSAT or INTELSAT charges in proportion to their use of INTELSAT capacity .39 In the case of U.S. international carriers, the charges for leasing **COMSAT circuits are current costs and can, of course, be recovered from their customers, but the satellite charges are not capitalizable and therefore do not enter the carriers' rate bases.[40]**

32If the component of International telecommunications where satellites have a technical or cost advantage is one-fourth of the total and is growing at the same rate as transatlantic telecommunications as a whole (1 6.2 percent per annum in the USISC forecast for the North Atlantic), it alone would equal the total current international telecommunications volume in 9 years

33We use the term "international regulatory regime" (or "international communications regime") broadly to include all governmental and intergovernmental actions affecting the operations of the international communications carriers, These include treaties and other formal and informal intergovernmental agreements in the area of telecommunications, other elements of international law affecting telecommunications, the actions of international organizations such as the ITU or INTELSAT, and the actions of national governments that affect the International telecommunications industry.

34The uniqueness of international communications arrangements is not always appreciated. "Single-vendor service" is now the norm in U.S. domestic long-distance communications and always has been in virtually all other markets in the U.S. economy, and even in most other international service markets. U.S. basic telecommunications providers (and those of other countries), however, are not free to offer single-vendor service in most international markets (i .e., to offer end-to-end communications service over their own owned or leased networks).

35Western Union International, inc., was separated from Western Union Telegraph Co., the former domestic record monopoly, in a divestiture that took place in 1963. (General Accounting Office, ***FCC Needs to Monitor a Changing International Telecommunications Market,*** RCED-83-92, Mar. 14, 1983, p. 22.) In 1982 WUI was acquired by MCI Corp. as a wholly owned subsidiary.

36If a customer was sited at one of the five "gateway cities" or at several other domestic "points of operation, " he or she was able to deal directly with one of the international record carriers without having to go through Western Union (General Accounting Office, ***FCC Needs to Monitor a Changing International Telecommunications Market, GAO/RCED-83-92,*** Mar. 14, 1983, p. 22). Western Union's monopoly status was never formally conferred by the FCC. How it used the regulatory process to preserve this status is a complex question (see Bruce M. Owen and Ronald Braeutigam, ***The Regulation Game*** (Cambridge, MA: Ballinger, 1978), ch. 1.

37COMSAT is part owner of INTELSAT, and receives offsetting return on its investment. Foreign international carriers from countries that do not belong to INTELSAT are able to use the system by paying the circuit charge.

38These should be distinguished from payments at the "accounting rate' which are calculated on the volume of telecommunications regardless of the transmission medium used. The country-pair partner that originates the greater volume of traffic compensates the other partner for its greater use, at the agreed-on accounting rate.

39The foreign PTTs and COMSAT, of course, collectively determine the INTELSAT unit charge through their weighted votes on the Board of Governors of INTELSAT. Table 6-5 and app. C give the voting weights of INTELSAT signatories.

40A number of U.S. international service carriers do have part ownership in the INTELSAT Earth stations (prior to recent changes COMSAT owned the other half) and can add the value of these facilities into their rate base. 1984 ownership shares were as follows: contiguous United States: COMSAT 50 percent, AT&T 35.5 percent, RCA 10.5 percent, MCI (WUI subsidiary) 4.0 percent; Hawaii: Comsat 50 percent, GTE (Hawaiian subsidiary) 30 percent, RCA 11 percent, ITT 6 percent, MCI(WUI) 3 percent; Guam: COMSAT 50 percent, RCA 48.9 percent, MCI(WUI) 1.1 percent (*Satellite News,* Dec 10 and 24, 1984).

Under the traditional regulatory regime, U.S. international carriers and satellite intermediaries were usually not allowed to penetrate very far into each other's markets. With only minor exceptions, the entry of new firms was also not allowed. Even when new firms were allowed in the United States, most foreign countries continued as they had in the past to allow only the traditional U.S. international service carriers (in voice only AT&T) to connect to their networks. For the international record carriers and COMSAT, U.S. international communications prices were regulated by the Federal Communications Commission under loose "rate of return on rate base" procedures.[41] For AT&T, no international rate base was separated; the firm retained greater discretion over international rates and could engage in price discrimination to the disadvantage of consumers of international communications.

Investment by the carriers in new facilities was also restricted—only cable or satellite facilities approved by the FCC and foreign governments were allowed. Investment by consumers was also restricted; only certain types of equipment, usually owned, manufactured, or supplied by carriers could be connected to their networks. Both of these restrictions constituted a severe barrier to international (and domestic) trade in telecommunications equipment and services and may have inhibited the full development of communications technology.

The Deregulated U.S. Industry: A New Element

Since the breakup of AT&Tat the beginning of 1984, a new more competitive U.S. telecommunications service industry has clearly emerged, with some of the largest U.S. corporation entering into what had been regulation-protected preserves. The formerly distinct industry compartments-voice and record, satellite and terrestrial, basic and enhanced, and domestic and international—have all been breached by large firms and smaller entrants, and each is now a competitive arena.

This vigorous new U.S. industry is also placing immense pressure on the international regulatory regime. Institutional and regulatory barriers to competition have allowed firms to earn high profits in international communications. Lured by these profits, many large firms in U.S. domestic telecommunications are seeking to expand their international activities (e.g., MCI, Western Union, and GTE). The list of potential new entrants into international satellite communications is large and growing (see table 6-4 for a partial listing of U.S. international communications firms).

Even though considerable domestic telecommunications deregulation has occurred in the United States, the old regulatory structures affecting U.S. international/ communications remain largely in place. While the FCC has relaxed the distinctions between international and domestic, satellite and cable, and voice and record carriers, this as yet has had little impact on which firms carry the bulk of each type of traffic and on how they do business internationally. AT&T Communications still carries almost all U.S. international telephone communications; the former international record carriers still handle most of the record traffic; INTELSAT and COMSAT still have a virtual monopoly on U.S. intercontinental space-segment communications; and the FCC still oversees a process in which approved carrier consortia plan facilities years ahead.

Competition in Foreign Telecommunications Service Markets

In "basic" telecommunications services,[42] international competition in foreign markets is practically nonexistent. While a few countries, notably the United Kingdom, Japan, and Canada, are moving toward privatization and limited domestic competition, most countries outside of the United States do not allow competition even in domestic long-distance telecommunications. A telecommunications monopoly, owned by the government (or, alternatively, in some cases a private monopoly regulated by the government) is the prevailing mode of industry organization around the world. Competition from foreign (including U.S. firms) is not yet envisaged even in countries allowing limited domestic competition .43 Foreign carriers must transfer control of communications passing into (or through the country) to the PTT at the international border or to an intermediate cable or satellite consortium that subsequently passes control to the PTT.

For regulation to have practical effect, a boundary has to be drawn somewhere between the regulated basic communications industry and the unregulated data processing industry, since they now merge into each other. [n contrast to the present situation in the United States, in most countries, the telecommunications administrations still attempt to draw this boundary so as to keep computer-enhanced communications services, such as "packet switching, " which

41 General Accounting Off Ice, FCC Needs to Men/for a Changing International Telecommunications Market, RCED-83-92, Mar. 14, 1983.

42 I.e., ordinary voice, record, data, and television transmissions, as opposed to "enhanced" or "value-added" communications, to produce which the provider uses computers to process or package them.

43 Except that Japan's new domestic telecommunications law seems to permit U.S. firms to operate some types of value-added networks within Japan.

increase the efficiency of communications in private networks, on the PTT monopoly side of the boundary.[44] In only a few countries are private firms, including U.S. corporations, allowed to compete freely in providing computer-enhanced communications service.

Further in the direction of information services are the value added networks (VANS). These are networks of computers that interact with each other in "real time, " that is, with little delay. For instance, users at keyboards in New York and other cities may wish simultaneously to query an industry data base in Philadelphia and use some of its software. The VAN operator buys communications capacity in bulk and uses its computers to make this communications network most efficient. In the United States these services have been fully deregulated since 1980.[45] The situation abroad is variable; in many countries, the PTTs still do not allow private firms to construct VANS, and the only VAN services available are those provided by the PTTs. In countries, such as Canada, United Kingdom, and Japan, that are experiencing a measure of domestic liberalization, competition is now allowed in the provision of VANS.

Control of international communications sent between adjacent countries–usually by land cable, undersea cable or terrestrial microwave—passes bilaterally at the border from one country's carrier to the carrier of the other country. In certain cases, however, governments and carriers have devised multilateral mechanisms of joint ownership for international satellites and transoceanic cables.[46]

As in the provision of basic international telecommunications services, competition between firms in the provision of international transmission facilities (with or without joint-venture affiliation) is also almost universally not allowed. The closest thing to competition in international facilities in the current regulatory regime is the competition between INTELSAT and the various transatlantic cable consortia. Even this competition is largely managed by overlapping PTT representation in INTELSAT and the cable consortia, by U.S. regulatory policies encouraging the "balanced" use of both kinds of facilities, and by facilities planning processes overseen by the FCC and other regulatory authorities.

Although in recent years the Commission has tried to back away from explicit satellite/cable use rules on the grounds that competition between the transmission modes should be allowed so that consumers would benefit, its 1982 "Authorized User" decision stated that the FCC would "continue to monitor the carriers' use of facilities to insure [that] both cable and satellite facilities are reasonably used[47] Using monthly circuit status reports, the FCC notes that "the existing policy has produced a satellite-cable facility usage ratio in the North Atlantic region of approximately 50-50 (specifically 48 percent cable, 52 percent satellite).[48]

The FCC is currently considering what transatlantic circuit distribution policy to follow in the 1985-95 period, since the current negotiated plan expires in 1985.[49] It is considering as alternatives: 1) continued use of "balanced loading,[50] 2) other distribution schemes, and 3) no FCC prescription of circuit distribution. The Commission recently tentatively concluded that transatlantic balanced use restrictions will still be necessary in the 1986-91 period.[51] Although no hint to the effect is given in the relevant FCC documents,[52] these distribution alternatives must be considered in the context of the large transatlantic capacity in the proposed new private satellite and fiber optic cable systems that may come to exist alongside the facilities of the cable consortia and INTELSAT. It must also take into account the growing private transborder regional system in the Americas.

The option of having no FCC circuit distribution prescription would not necessarily mean a significant change in the regulatory regime, however. The FCC could continue to approve the coordinated planning of new facilities within the North Atlantic Consultative Process by groups of U.S. and foreign carriers, who, as part of the process, would be likely to negotiate circuit loading rules. As long as facilities construction is regulated and individually owned facilities are not allowed, some formal or informal circuit loading rules are likely to be followed in any case. What is not clear, however, is how any but the most stringent circuit distribution requirements can protect the revenues of COMSAT/INTELSAT, if large alternative satellite and cable capacity comes into existence.

44Packet switching uses computer processing to group communications into packets going to common destinations.

45FCC, "In the Matter of Amendment of Section 64.702 of the Commission's Rules and Regulations [Second Computer Inquiry]," FCC-80-1 89, final decisions, released May 1980.

46See ch. 6 for descriptions of the INTELSAT, I NMARSAT, and the transatlantic cable consortium.

47General Accounting Office, Op. Cit., p. 43.

48NOI, op. cit., p. 9.

49The U.S. international carriers have also stated that they would like to see a reevaluation of the circuit loading policy ("Contribution of the U.S. Delegation to the North Atlantic Consultative Working Group, Paris, France, Jan. 31-Feb. 2, 1984, unpublished, p. 41).

50Balanced loading is defined in note 46, p. 161.

51FCC, 'Second Notice of Proposed Rulemaking In the Matter of . . Authorization of Common Carrier Facilities to Meet North Atlantic Telecommunications Needs During the 1985-1995 Period, " FCC 85-176, released Apr. 22, 1985.

52Ibid., and NOI, op. cit.

Pricing

The pricing of international telecommunications to consumers is in most cases determined solely by the carrier and/or regulatory authority of the originating country. Rates for calls originating in (or collect to) a country can therefore differ tremendously from rates of calls going the other way, frequently by a factor of more than **2.** In most cases, U.S. rates are significantly lower than the rates of other countries (even with the strong dollar), but nevertheless, as a recent executive branch white paper states, "International service, in short, costs between two and three times comparable U.S. domestic service. [53]

In virtually all countries, international telecommunications profits cross-subsidize various unrelated activities. The surplus from international operations is transferred by administrative or regulatory action to such other activities as local or domestic long-distance phone service (e.g., the United States), the postal service (Germany), or even bus service (Switzerland). At stake in current telecommunications regulation, therefore, are the interests of the subsidy recipients as well as the carriers and buyers of international telecommunications services,

Deregulatory Moves in International Telecommunications

To date most of the actions taken to liberalize international telecommunications have been in the United States, although some moves in this direction have taken place in Canada[54] and the United Kingdom.[55] Even though domestic deregulatory actions have not been taken to any great extent in most other industrial countries, all are wrestling with the need to erect a practical perimeter around the regulated or state-owned sector that can effectively differentiate it from the growing array of computer-enhanced communications applications outside the perimeter without stunting their development. [56]

The deregulatory moves the United States has taken in international telecommunications can be explained mostly as the straightforward result of domestic deregulatory actions that have, insofar as possible, removed the regulatory distinctions between firms. For instance, the dropping of the distinction among voice and record carriers could not easily be maintained by the FCC in international communications after it had abandoned it in domestic communications. As a practical matter, it would also be difficult for the FCC to discriminate in international communications among the major U.S. corporations that are now the vigorous new competitions in domestic markets. In theory at least, discrimination is now left to foreign governments beyond the control of the FCC and to the market.[57]

COMSAT'S special status as the monopoly wholesaler of INTELSAT services is an exception to this. By law and regulatory action, COMSAT has the special status of a carrier's carrier with monopoly access to INTELSAT space segment facilities. The FCC would like to control and dilute this special status, however, and see COMSAT evolve primarily into a general communications carrier.[58] The FCC's 1982 decision to allow COMSAT to sell to consumers directly was to be a step in this direction, but it was suspended until 198s by court decision and may continue to accrue court challenges.[53] In 1984, the FCC first allowed communications firms to own limited-use INTELSAT Earth stations. Traditional INTELSAT Earth stations have been owned 50 percent by COMSAT and 50 percent by the international carriers using them. The FCC altered this policy by approving the applications of several carriers to construct and operate special Earth stations in Chicago, New York, Washington, and other cities for INTELSAT Business Service (IBS) (primarily data and videoconferencing) and expects to approve other similar applications in the future.[60] It then fol-

[53] Departments of State and Commerce, "A White Paper on New International Satellite Systems, " op. cit., p. 42.

[54] See Joseph s. Schmidt and Ruth M. Corbin, "Telecommunications in Canada: The Regulatory Crisis, " *Telecommunications Policy,* vol. 7, September 1983, pp. 215-227.

[55] See Andrew C. Brown, "For Sale: Pieces of the Public Sector, " Fortune, vol. 108, Oct. 31, 1983, pp. 78-84, for a discussion of the privatization of British Telecom. Also "Evaluating Telecom's Outlook, " New *York Times,* p. D1. Actual sale of 50.8 percent of the stock to the public took place on Nov. 28, 1984. A second domestic interexchange carrier has also emerged: Cable & Wireless' wholly owned subsidiary, Mercury Communications. See also Eli M. Noam, "Telecommunications Policy on the Two Sides of the Atlantic: Divergence and Outlook, " op. cit.

[56] See Marcellus S. Snow, "Telecommunications Deregulation in the Federal Republic of Germany," *Columbia Journal of World Business,* vol. 18, No. 1, spring 1983; and Dan Schiller, "The Storming of the PTTs," *Datamation,* May 1983, pp. 155-158.

[57] The FCC provisionally still regulates A T&T as the dominant carrier both domestically and internationally and also the other international carriers in most international markets, since competition at present is Insufficient to eliminate market power. Legislation, such as the Record Carrier Competition Act of 1981, guides the FCC in making the transition and in residual regulation of nondominant carriers.

[58] See main ch. 6 for a discussion of other alternative means of dealing with COMSAT's future status.

[59] It has already come under fire. A number of US carriers petitioned the FCC to be allowed to acquire capacity in the INTELSAT system parallel to COMSAT, in much the same way that they now own capacity in transatlantic cables. The FCC recently turned them down and closed the issue for the time being, but it will undoubtedly be raised again at some time in the future, perhaps as an alternative to private satellite ownership (*Satellite* News, Apr. 2, 1984, p. 2).

[60] As of January 1985, besides that of COMSAT, the FCC had approved applications of the following firms or their subsidiaries to *distribute INTELSAT* Business Service: International Relay, Inc., ITT Corp., United Brands Co. (subsidiary: TRT Telecommunications, Inc.), IBM Corp. (joint venture subsidiary: Satellite Business Systems), Satellite Gateway Communications, Inc., Vital Ink International Communications, Inc., McDonnell Douglas (subsidiary: FTC Satellite Systems, Inc.), and United Video, Inc.

lowed this by removing the requirement that COMSAT must own a half share of the general-purpose INTELSAT Earth stations.[64]

In the view of some, this evolution is too slow. In their view, it may allow COMSAT to take advantage of its special position in international communications to unfairly cross subsidize its competitive domestic activities, despite the special accounting rules devised by the FCC to minimize the possibility.

The FCC's abandonment of the distinctions between international voice and record carriers and international and domestic carriers, together with its moves to end the special position of COMSAT, already make a significant difference in the way the U.S. industry faces the world. What the changes mean collectively is that all U.S. communications carriers (except COMSAT, for the present) will be allowed to operate in international communications markets in the nearly same way as far as the U.S. Government is concerned.

What this will mean in terms of actual competition in the intermediate-range future is in doubt, however. First, AT&T currently has a dominant position in international service markets: at the end of 1983, AT&T alone was using approximately 88 percent of all cable and satellite circuits in service between the United States and Europe just for message telephone service.[62]

Despite its important domestic deregulatory moves, the FCC has been rather cautious in extending deregulation directly into international communications. For the most part, the foundations of the international communications regime, in which competition is severely limited, have not been touched.

Restrictions on facilities construction, ownership, and use, for instance, are one of the key elements in the current international communications regulatory structure. Up to 1985 the FCC continued to approve carrier facilities agreements and implicit or explicit balance criteria. The proposed transatlantic TAT-8 cable, for instance, which received FCC approval in 1984, will be jointly owned by the traditional U.S. international service carriers, together with foreign PTTs and governments. Likewise, INTELSAT, among other things, is a satellite cartel, and the FCC has been a strong supporter of INTELSAT. The pending applications for private "international" and "transborder" facilities, however, are forcing the FCC to reevaluate its position on facilities. The reevaluation also appears to be underway in the current inquiry on facilities loading. Whether this reevaluation will result in important U.S. deregulatory moves in international communications is not clear.

[61] FCC, "Second Report ., .," op. cit., Jan. 1 1, 1985,
[62] NOI, op. cit., p. 12.

The changes that have already taken place in the international regulatory regime mean that the international communications game will now be played by a greater number of potential U.S. players. This introduces one new element, the increased ability of the PTTs to use their monopoly power at the expense of competitive U.S. carriers (and consumers) by favoring those U.S. carriers which offer the most advantageous terms.[63] In the extreme, this would mean selling the right to interconnect to the single highest bidder. In this way, PTT could get most of the excess profit obtainable from the monopoly structure.

Care needs to be taken in interpreting the prices ("accounting rates") paid by international carriers to their country-pair partners ("correspondents") in other countries. With certain exceptions, notably private lines, carriers derive revenues only from customers sending outbound communications and do not charge for inbound ones. Since country-pair traffic flows are usually unbalanced, sometimes with heavy net flow in one direction, there is a need for the carrier with the heavier flow (and heavier collection of tariff revenue from customers) to compensate the carrier that is the net communications recipient for the uneven use of jointly provided facilities.

It is a two-step procedure. First, there is a barter mechanism, whereby minutes in one direction are traded one-for-one for minutes in the other direction, up to the level of the smaller directional flow. The country-pair partners then complete the settlement by negotiating a price for the excess minutes, the "accounting rate." This is than multiplied by the number of excess minutes to determine the amount to be paid to the net recipient. These payments are made regardless of which transmission mode is used and, therefore, cover communications sent both by cable and satellite,[64]

For voice service, there is a net communications outflow from the United States, and U.S. carriers therefore typically make payments to the PTTs. Any increase in the accounting rate that a foreign PTT could negotiate with U.S. voice carriers would therefore typically increase the operating expenses and decrease the net revenues of the U.S. carriers. For record service, the reverse movement in the accounting rate would disadvantage U.S. carriers. While there is some variation in directional flow among individual U.S. record carriers, the record carriers as a group have more traffic flowing into the United States than

[63] According to GAO, op. cit., p. 18, the PTTs or groupings of PTTs representing Belgium, Luxembourg, the Netherlands, Denmark, Finland, Iceland, Norway, and Sweden invited potential suppliers of data communication services to make accounting rate bids on existing and new services.
[64] The partners also negotiate an exchange rate, the "settlement rate, " so the payment can be made in the appropriate currency.

out. Here PTTs typically gain by pressuring U.S. record carriers to decrease the accounting rate, which, decreases the revenues of U.S. carriers.

To combat the use of PTT monopoly power to disadvantage competitive U.S. carriers, the FCC has mandated that all potential U.S. connectors agree on a single accounting rate. Ironically, this discourages competition among the U.S. carriers, and, in particular, does not allow new entrants to compete on the basis of price. It thereby lessens the benefits that consumers derive from increasing international competition.[65] It also illustrates the broader principle that halfway liberalization of markets may have unintended consequences.

Entry Into U.S. International Satellite Communications Markets

In most foreign countries, when there is more than one potentially connecting U.S. firm, each country determines which carrier or carriers it will interconnect with and which it will exclude in each market segment.[66] The arrangement is facilitated by joint ownership of oceanic cables. For instance, the planned TAT-8 and TAT-9 fiber optic cables are to be owned jointly by a consortium of AT&T, seven other U.S. international carriers, British Telecom, French Telecom, and virtually every PIT in Europe. The Hawaii 4/TRANSPAC-3 cable that is to link the U.S. mainland to Japan and several other Asian countries in 1988 or 1989 will be also jointly owned by numerous telecommunications entities (22 in all from North America, the Pacific region, and Europe).

In both the North Atlantic and Western Hemisphere satellite arenas, deregulatory pressures from the U.S. private sector have recently become intense. They are currently manifesting themselves mainly in attempts to enter communications markets with private facilities. The traditional U.S. international service carriers, augmented by Western Union Telegraph Co., MCI international, and GTE Sprint, require correspondent relationships with the PTTs of the destination countries, and while some entry is taking place in these markets, they are not the scene of the most active entry. Western Union's ability to enter many international record markets, since being allowed to by the FCC, and MCI International's entry into the United Kingdom, Belgium, Brazil, and other voice markets in late 1984/early 1985 are the most notable events. The most active entry is currently being attempted in transatlantic and Western Hemisphere satellite facilities markets (as described above, in ch. 6) and in markets for business communications facilities, such as INTELSAT Business service.

[65] This Point is made in an unpublished paper by Eli Noam presented at the Research Workshop on Economics of Telecommunications, Information and Media Activities in Industrial Countries, National Science Foundation, Apr. 30-May 2, 1984, Washington DC.

[66] In the United States, the Federal Communications Commission has required Interconnection. Nevertheless, since usually there was only one foreign carrier to connect with in each market, the market structure in country-pair markets remained noncompetitive.

APPENDIX 6B.–THE COMMUNICATIONS SATELLITE EQUIPMENT MARKET

Introduction

The large-scale development of the satellite communications service industry has been paralleled by the requisite development of a large satellite equipment industry. Estimated worldwide investment in commercial communications satellites from 1965 to 1985 (not including the Soviet Union) will have been $4.8 billion with 132 launches.[1] This is shown in figure 66-1, which breaks out this investment for various countries, organizations, and regions.

Some analysts foresee continued expansion in communication satellite systems. In one recent optimistic forecast, for instance, the world market for satellite communications equipment in the 1980-2000 period is projected to be $30 billion to $50 billion.[2] Expansion and periodic replacement of the world's satellite communications systems, which will require continuing future investment in satellites and ground segment equipment, is included in this projection,

While this is consistent with one of the possible futures for satellite communications, previous analysis in chapter 6 concluded that the demand for international satellite communications services on which the demand for satellite equipment depends, is highly uncertain, particularly in the 1990s. Although the domestic markets for satellite communications in the United States and other countries are not analyzed in this assessment, it is clear that demand for domestic, as well as international, satellite services and for equipment to provide them is also highly uncertain.[3] Consequently, considerable skepticism of both U.S. and worldwide projections of satellite communications equipment demand is warranted.

Satellite Markets

The bulk of satellite communications services (outside the Soviet bloc) in the 1980s and 1990s will be provided by INTELSAT and other global systems,[4] regional systems such as ARABSAT, PALAPA, EUTELSAT, and the potential private Western Hemisphere and transatlantic systems; and national systems, particularly those of the United States, Canada, Mexico, Brazil, Japan, India, China, and Australia. The latter are starting to provide increasing amounts of transborder service to neighboring nations; consequently, the distinction between national and regional will become less clear. Information on major international communications and direct broadcast satellites (DBS) which are in use already or reasonably certain to be orbited soon are listed in table 66-1.

The United States is the world's largest single market for satellite communications equipment. One estimate places **U.S.** investment in commercial communications satellites at $1.63 billion between 1965 and 1985 as shown in figure 66-1 and $3.19 billion between 1986 and 1989 as shown in figure 6B-2. In April 1983, the Federal Communications Commission (FCC) authorized 19 new communications satellites for launch by 1987–more than are to be launched by the rest of the non-Communist world combined.[5] Pending before the FCC are applications for over 50 more communications satellites (represented by 22 differ-

[1] R. Filep, A. Schnapf, and S. Fordyce, "World Communications Satellite Market Characteristics and Forecast," prepared by Communications 21 Corp., Redondo Beach, CA, for the NASA-Lewis Research Center, Cleveland, OH, NASA CR-168270, November 1983.

[2] See Ted Lanpher, "ACTS: The Case for U.S. Investment in 30/20 GHz," *Satellite Communications,* May 1983. A second projection for the world equipment market between 1983 and 1990 in just the 14/12 GHz Ku band is $25 billion, peaking in 1988-89. Interview with Dennis Fraser, Corporate Vice President and General Manager, NEC America Broadcasting Equipment Division and Executive Vice President Alcoa-NEC Communications Corp. as quoted in *Satellite Week,* Mar. 28, 1983, p. 7.

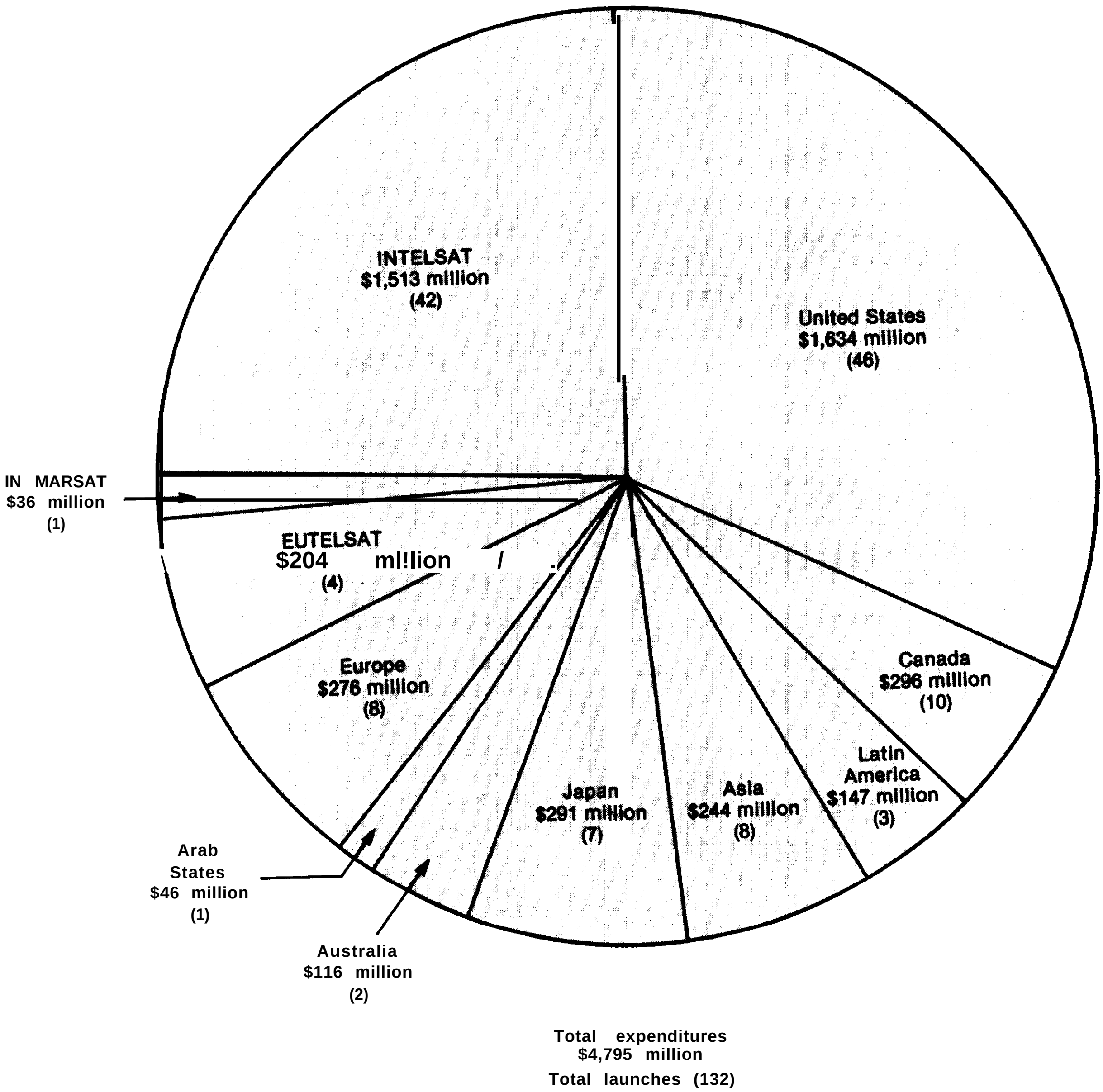
[3] For a recent forecast of the demand for U.S. satellite and terrestrial telecommunications capacity, see S. Stevenson, W. Poley, J. Lekan, and J. Salzman, "Demand for Satellite-Provided Domestic Communications Services to the Year 2000, " Technical Memorandum 86894, NASA, Lewis Research Center, Cleveland, OH, November 1984, For the decades of the 1980s and 1990s, the authors forecast the average annual demand for long-haul communications capacity in the United States to grow at 1.6 and 3.8 percent respectively, but that the demand for satellite capacity will grow at 10.4 and 7.5 percent, respectively. In their projection, the ratio of total satellite demand to total long-haul demand increased rapidly from 0.15 in 1980, to 0.35 in 1990 and 0.51 in 2000. The authors project an even more dramatic increase in the ratio of business services demand for satellite capacity (data and video [mostly videoconferencing]) to demand for total long-haul capacity for these services: 0.11 (1 980), 0.56 (1 990) and 0.87 (2000). This, therefore, presents one view of the outcome of technological competition between satellites and fiber optic cables. In addition, commercialization of space ventures such as launch vehicles and materials processing may divert investment capital from communications satellites. See Jay C. Lowndes, "Increased Space Commercialization May Tighten Investment Capital," *Aviation Week and Space Technology,* Apr. 29, 1985, pp. 123-128.

[4] E.g., INMARSAT.

[5] Personal communication, FCC, May 1985. No more have been authorized since April 1983. In addition, the authorizations granted in April 1983 to Advanced Business Communications, Inc., Rainbow Satellite, Inc., and United States Satellite Systems, Inc., all in Ku-band, have since been declared null and void. The FCC hopes to have the pending applications settled by August 1985, prior to ORB-85.

[6] including spares, but not including previously built replacement satellites. Much of this capacity is for private business networks which bypass the local terrestrial telephone networks. Reasons why businesses have invested in such private bypass facilities are that they can avoid cross subsidizing residential phone service, they may be able to gain types of service not available over the public network, and large users might find their own networks to be economic since they can design them without provision for redundancy. (For a discussion of these issues, see House of Representatives, 98th

Figure 6B-1.—Estimated Worldwide Investment in Commercial Communications Satellites,[a] 1965-85
(1983 dollars)



[a]Does not include the Soviet Union.

SOURCE: Data from: R. Filep, A. Schnapf, and S. Fordyce, "World Communications Satellite Market-characteristics and Forecast," prepared for NASA by Communications 21 Corp., NASA CR-168270, November 1983, p. 12.

Congress, Committee on Energy and Commerce, Report on HR 4102, Universal Telephone Service Preservation Act of 1983, Report No. 98-479, Nov. 3, 1983; "FCC Needs to Monitor a Changing International Telecommunications Market, " General Accounting Office, Washington, DC, Report RCED-83-92, Mar 14, 1983; "Efficiency vs Comity in U.S. International Telecommunications Regulation, " by Douglas L. Adkins, paper presented at the Society of Government Economists' Session on International Regulation, ASSA Meetings, Dallas, TX, Dec 28, 1984; and "Breaking Up AT&T" by Mary H Cooper, *Editorial Research Reports*, vol. 11, No. 23, Dec 16, 1983.

ent companies) and about 18 direct-broadcast satellites.[7] Not all of these satellites will be built, partly because a number of the firms are requesting the same

[7]See "FCC Approves 4 Firms for Satellite TV, *Aviation Week and Space Technology*, Oct. 15, 1984, p. 22; and "Four Firms Win Approval of FCC for TV Satellites, " *Aviation Week and Space Technology*, Dec. 17, 1984, p, 18

Table B=l.—International Communications and Direct Broadcast Satellite Series

Name	Date	Owner	Manufacturer	Technical characteristics
AM ERSAT	1985, 86	American Satellite (jointly owned by Fairchild Industries and Continental Telephone)	RCA Astro-Electronics	Six Ku-band (14/12 GHz) transponders plus 12 C-band (6/4 GHz) transponders
ARABSAT	1985, 86	Arab Satellite Organization	Aerospatiale/Ford Aerospace	25 C-band transponders plus 1 S-band transponder
Anik	1978, 82, 84	Telesat Canada	Anik B-RCA Astro-Electronics, Anik C-Hughes Aircraft, Anik D-Spar Aerospace/Hughes	Anik B, 18 transponders; Anik C, 16 transponders; Anik D, 24 transponders. All Ku or C-band or combination
BS 2	1984, 85	NASDA	ToshibalGeneral Electric	2 Ku transponders covering all Japanese territory
BSE	1978	NASDA		
Comstar	1976, 78, 81	COMSAT Corp.	Hughes Aircraft	24 transponders at 6/4 GHz
Cs 2	1983	NASDA	Mitsubishi Electric/Ford Aerospace	Six Ka-band (30/20 GHz) plus 2 C-band transponders
ECS	1984, 85	EUTELSAT	British Aerospace Dynam. leading Mesh consort.	12 Ku transponders
Galaxy	1983	Hughes Communications	Hughes Aircraft	24 transponders at 6/4 GHz
Gstar	1984, 85	GTE Satellite	RCA Astro-Electronics	16 transponders at 14/12 GHz
Morelos	1985, 86	Mexican Government	Hughes Aircraft	22 transponders (mix of Ku and C-band)
INTELSAT IV	1974, 75, 76, 77	INTELSAT	Hughes Aircraft including participation by British Aerospace Dynamics, Thomson-CSF, AEG-Telefunken, Selenia, NEC	12 C-band transponders
INTELSAT V	1978-84	INTELSAT	Ford Aerospace leads a team that includes Aerospatiale, MSDS, MBB, Mitsubishi, Selenia, and Thomson-CSF	21 transponders at 6/4 GHz plus 6 at 14/11 GHz
INTELSAT VI	1986-	INTELSAT	Hughes Aircraft, including shares by British Aerospace Dynamics, Spar Aerospace, Thomson-CSF, Selenia, NEC, MBB, Comdev, and AEG-Telefunken	36 transponders in C-band plus 10 transponders in Ku-band
ITALSAT	1987	Italy (Telespazio)	Aeritalia and Selenia	6 transponders in Ka-band
L-Sat (Olympus)	1986, 90	ESA	British Aerospace Dynam. leads; team includes Selenia, Marconi, BTM, and Telespazio	2 transponders for direct broadcast TV; transponders for business services plus 30/20 GHz Ka
Marecs	1981, 82, 84	INMARSAT leases craft from ESA	British Aerospace Dynamics (payload made by Marconi Space & Defense Systems)	Two transponders can relay 30 to 50 voice channels simultaneously
Marisat	1976	COMSAT Corp.	Hughes Aircraft	Transponders in VHF, L-band, and C-band

"This includes all major satellites currently in service in the Western world as well as new ventures with a firm go-ahead. Derived from "International Satellite Directory-Flight Data," *Flight International*, May 14, 1983, pp. 1311.1330 and *Satellite Communications Notebook*, 1984.
.'Retrieved November 19S4 after a previous failed mission.

NOTE: All satellites are geosynchronous.

Table B-1 .—International Communications and Direct. Broadcast Satellite Series—Continued

General information	Design life (years)	Launch
Two satellites ordered so far by American Satellite	AM ERSAT A, 8.5 yrs. AM ERSAT B, 10 yrs.	Shuttle
Will provide television, voice, and data links among Arab League countries	7	Ariane, Shuttle
Used for Canada's domestic network of communications satellites	Anik B, 7 yrs. Anik C, 8 yrs. Anik D, 9 yrs.	Delta, Shuttle
There will be two craft in orbit. Will bring television to Japanese islands and mountainous regions	5	N-11
Medium-scale broadcasting satellite for experimental purposes	NIA	Delta
A series of four U.S. domestic communications craft, leased by AT&T	7	Atlas-Centaur
Japan's first operational domestic communications satellites. The network comprises two craft in orbit	3	N-11
European Communications Satellite. Five ECS are being built, procured for Eutelsat by ESA	7	Ariane
A series of three craft which Hughes Comm. will own and operate	9	Delta
The first domestic communications craft bought by GTE; they previously leased	10	Ariane
Mexico's first domestic communications satellite; will relay television, telephone calls, and data	9	Shuttle
Older generation INTELSAT. Presently three IVS are in service as well as four INTELSAT IV As	7	Atlas-Centaur
The largest series of communications satellites in the world, providing two-thirds of all international links	7	Atlas-Centaur, Ariane
INTELSAT'S future generation of satellites. The initial contract was for 5 craft, with options for up to 11 more	10	Ariane 4 or Shuttle
Italy's first domestic communications craft-intended as semi-operational	10	Ariane or Shuttle
Large Satellite (L-Sat) is Europes' entry into direct broadcast satellites and business communications	Olympus-1, 5 yrs. Olympus-2, 10 yrs.	Ariane
Europe's first maritime communications satellite. Marecs A INMARSAT debut was May 1, 1982	7	Ariane
Worlds first maritime communications satellite. Used by U.S. Navy and IN MARSAT to provide ship-shore link	8	Delta

"This includes all major satellites currently in service in the Western world as well as new ventures with a firm go-ahead. Derived from "International Satellite Directory-Flight Data," Flight *Irrterrrational,* **May 14, 1983, pp. 1311-1330 and Satellite Communications *Notebook,*** 1984.

• "Retrieved November 19S4 after a previous failed mission.

NOTE: **All satellites are geosynchronous**

Table B-1.—International Communications and Direct-Broadcast Satellite Series—Continued

Name	Date	Owner	Manufacturer	Technical characteristics
PALAPA	1976, 77, 84, * •85	Permutel (Indonesian telecommunications administration)	Hughes Aircraft	12 transponders in C-band; 1, 2 24 transpond. in C-band; 61, 62
Postsat	1986 or 87	German Ministry for Post and Telecommu-nications	MBB/ERNO (as subcontractor to Siemens)	7 transponders at 14/12 GHz plus *3* at 14/11 GHz plus 1 experimental 30/20 GHz
Satcom	1975, 76, 81, 82, 83, 85	Satcom I and 11: RCA American Comm., Satcom III onward: Americom	RCA Astro-Electronics	24 transponders at 6/4 GHz
S0S	*1980, 81, 82*	SBS was consortium of Aetna Life & Casualty, COMSAT Corp. and IBM. COMSAT recently opted out	Hughes Aircraft	10 active transponders at 14/12 GHz (Ku-band)
Spacenet	1984, 85	Southern Pacific Communications	RCA Astro-Electronics	12 transponders in C-band plus 6 in Ku-band
TDRS	1983, 85	Spacecom (consortium of Continental Telephone, Fairchild Industries, and Western Union)	TRW Defense and Space Systems	2 S-band transponders, duplex single access; 2 Ku-band, duplex single access; IS-band 20-user mult. access (RO), 1 timeshare multiple access (TO); 12 C-band
Telecom 1	1985	French Ministry of Telecommunications/ CNES	Matra Space with participation by European industry	6 transponders at 14/12 GHz covering France plus 4 at 6/4 GHz covering Africa and French Guiana plus 2 at 8/7 GHz for French govt.
Telstar 3	1983, 84, 85	American Telephone & Telegraph (AT&T)	Hughes Aircraft	24 transponders at 6/4 GHz, in-creasing to 30 in later series
Unisat	1986	United Satellites, a consortium of British Telecom, British Aerospace Dynamics, and Marconi Space & Defense Systems	British Aerospace Dynamics (payload by Marconi)	2 direct-broadcast television channels plus 4 trans-ponders for mixed business use
Westar	1974, 79, 82, 84* •	80 01. Western Union and ZOO/o American satellite	Hughes Aircraft	1, 11, Ill: 12 transponders at 6/4 GHz IV, V: 24 at 6/4 GHz
Direct-Broadcast:				
AUSSAT	1985	Aussat	Hughes Aircraft	4 transponders with 30W power plus 11 with 12W power. All are 14/12 GHz
STC	1986	STC, a subsidiary of COMSAT Corp.	RCA Astro-Electronics	3 transponders at 14/12 GHz
Tele-X	1986	Swedish Space Corp.	Aerospatiale as prime, plus Saab-Scania, LM Ericsson, and Eurosatellite consort.	3 direct-broadcast transponders (12 GHz) plus transponders for video and data relay
TDF 1	1986	TDF	Eurosatellite	3 active direct-broadcast Ku band plus 2 spares
TV-Sat	1985	German Ministrv for Post and Telecom".	Eurosatellite	3 active direct-broadcast transponders DIUS *2* st)ares

● This includes all major satellites currently in service in the Western world as well as new ventures with a firm go-ahead. Derived from "Intemational Satellite Directory-Flight Data," *Flight International,* May 14, 19S3, pp. 1311-1330 and Satellite *Communications Notebook,* 1984.
"● Retrieved November 19S4 after a previous failed mission.

NOTE: All satellites are geosynchronous

Table B-1.—International Communications and Direct-Broadcast Satellite Series—Continued

General information	Design life (years)	Launch
Indonesia's first generation of communications satellites, PALAPA I and 2 are being replaced with PALAPA B1 and B2	PALAPA I and 2, 7 yrs., PALAPA 61 and 62, 8 vrs.	Delta, Shuttle
West Germany's first domestic communications satellite, also known as DFS; three craft built, two to be orbited	7	Ariane 3 or 4
Series of U.S. domestic communications satellites relaying cable television and other services. Currently comprises six satellites	7, 10	Delta
Satellite Business Systems (SBS) was first to provide a satellite network aimed at business users. Provides links among companies within the Us.	7	Delta, Shuttle
Southern Pacific has ordered four craft for its first network	8.5	Ariane 3, Ariane or Shuttle for #3 and #4
NASA's tracking and data-relay satellite system (TDRSS) is designed to provide a more comprehensive communications link between spacecraft and the ground	10	Shuttle
France's first domestic communications satellite will relay telephone calls, television, and data within France and provide link with French overseas departments	7	Ariane 2 or 3
The first domestic communications satellites owned by AT&T, which previously leased capacity on Comstars owned by COMSAT	10	Delta, Shuttle
Britain's first direct-broadcast television satellite, whose two channels have been allocated to the BBC. Unisat is a private venture	7 to 10	Ariane or Shuttle
The bulk of Western Union's traffic is now carried by Westars Ill, IV, and V	1, 11, Ill: 7 yrs. IV, V: 10 yrs,	Thor-Delta, Shuttle
Australia's first domestic communications satellite. AUSSAT has two main functions—direct broadcast TV and radio, and the relay of TV, telephone calls. data. etc.	7	Shuttle
Satellite Television Corp. was the first company to win approval for a direct broadcast television network in the U.S. STC will eventually have a network of four operational craft serving all 50 StakS	7	Shuttle, Ariane option
First export application of the French-German TV-Sat/TDF 1 direct-broadcast television satellite	5	Ariane
France's version of the direct-broadcast television satellite, being develor)ed with West Germany	7.5	Ariane
West German version of a direct-broadcast satellite being developed jointly with France, outside the framework of ESA	7.5	Ariane

● This includes all major satellites currently in service in the Western world as well as new ventures with a firm go-ahead Derived from "International Satellite Directory-Flight Data, " *Flight International*, May 14, 1983, pp. 1311.1330 and *Satellite Communications Notebook, 1984*
." Retrieved November 1984 after a previous failed mission

NOTE: All satellites are geosynchronous

geosynchronous orbital slots in the C (6 GHz uplnak/4 GHz downlink) and Ku (14/12 GHz) bands.[8] Several of the proposed satellites will either have to be placed in less desirable slots, not launched, or redesigned to transmit in the higher frequency Ka (30/20 GHz) band.[9] The present transponder oversupply or inroads made by fiber optic systems could also reduce the number launched.[10] Geostationary commercial communications satellite locations, present and planned as of June 1984, are shown in figures 6B-3 and 6B-4.

The next largest civilian communications satellite market is INTELSAT, now operating 16 satellites with a network of 173 receiving and transmitting Earth stations located in 146 countries, dependencies, and areas of other special sovereignty.[11] In most cases, the Earth stations themselves are owned and operated by the international telecommunications organizations of the member countries in which they are located. INTELSAT has contracted for nine INTELSAT V and V-A satellites to be launched between 1983 and 1986 and five of the new INTELSAT VI models for 1986-87 launches.[12] Options exist for an additional 11 INTELSAT VIs, which, if built, are projected for launch in 1988 and onward. Anticipated INTELSAT investment in commercial communications satellites between 1986 and 1989 at $1.2 billion would be second only to that of the United States ($3,19 billion) as shown in figure 6B-2.

Several other satellite systems, for which the satellites have already been contracted, may later require replacement or follow-on satellites. These systems include that of the International Maritime Satellite Organization (I NMARSAT) and others listed in table 6B-1 such as ARABSAT, ANIK,[13] PALAPA, and AU SSAT. Japan apparently plans a larger satellite series to follow its current series.[14] France has not announced plans

[8] The geostationary orbit is becoming increasingly congested, as shown in figs. 6B-3 and 6B-4 and allocation of these slots will be a major issue in the upcoming Space WARC '85, Some technical solutions will help alleviate but not solve the seriousness of the congestion. See, for example, L. Pollack and H. Weiss, "Communications Satellites: Countdown for INTELSAT VI," *Science*, Feb. 10, 1984, pp. 553-559; and Walter L, Morgan, "Satellite Locations—1984," *Proceedings of the IEEE*, vol. 72, No. 11, November 1984, pp. 1434-1444.

[9] See for example: Chris Bulloch, "Space Communications Move Into the Millimetre-Wave Bands," *Interavia*, May 1984, pp. 461-463; "Advanced Technology Satellites in the Commercial Environment," vol. 2, final report, prepared by Future Systems Inc., Rockville, MD, for NASA-Lewis Research Center, Cleveland, OH, March 1984; and C. Richard Whelan, "Communications Satellites Move to Higher Frequencies," *High Technology*, November 1984, pp. 48-53.

[10] See for example: "satellites OutPace Customers—Gap Viewed as Cyclical," *The New York Times*, Apr. 10, 1984; or Stephen Shaw, "Business Outlook-Satellite Operators Bet on Demand Surge," *High Technology*, November 1984, p. 54.

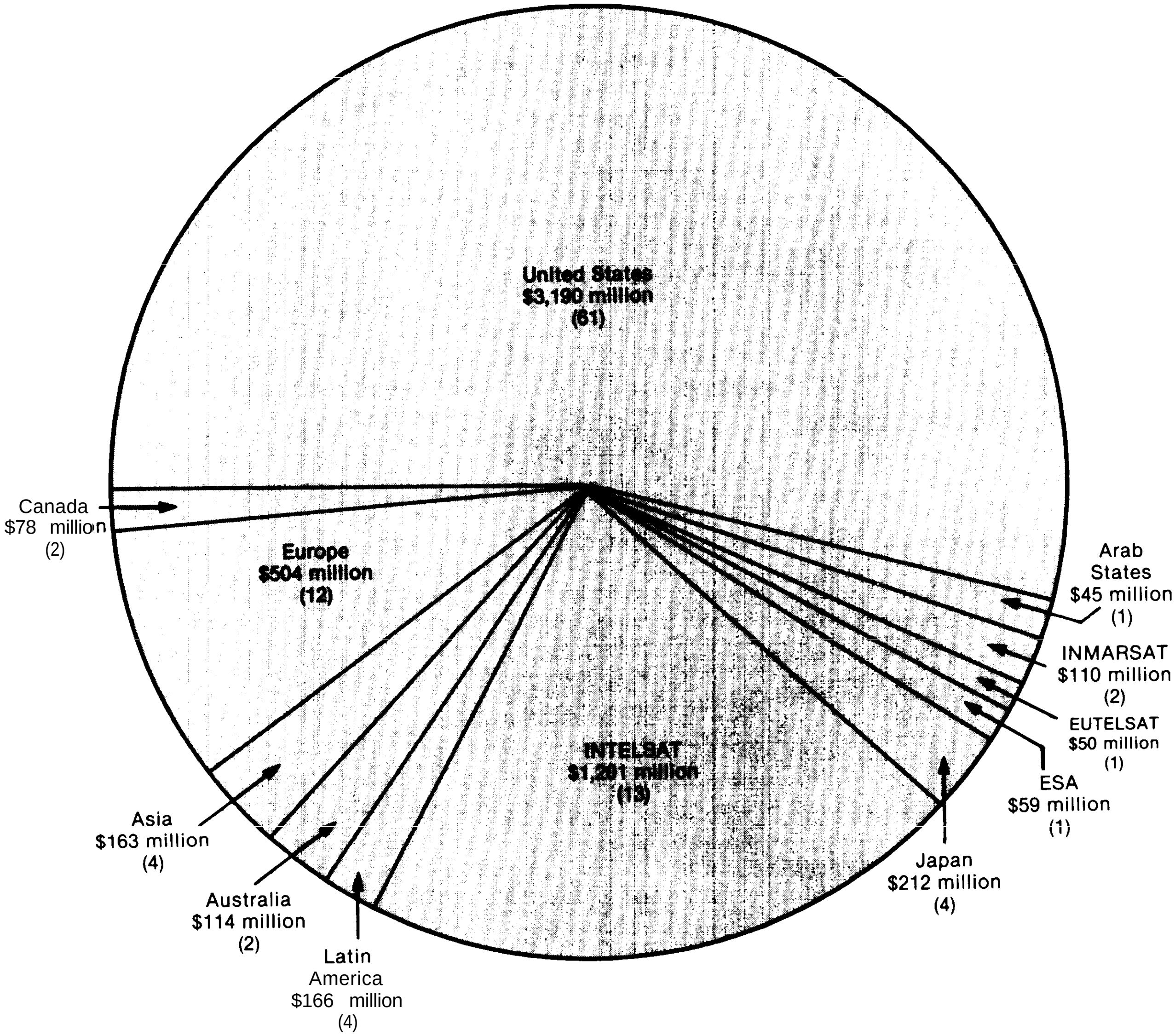
[11] INTELSAT, *Annual Report*, Washington, DC, 1983, p. 9.

[12] Personal Communication, INTELSAT, November 1984; Pollack and Weiss, op. Cit.

[13] See however, "Mature Market to Affect Next ANIK Generation," *Aviation Week and Space Technology*, Dec. 10, 1984, pp. 87-88.

[14] Filep, Schnapf, and Fordyce, op. cit., p. 89.

Figure 6B"2.— Estimated Worldwide Investment in Commercial Communications Satellites,[a] 1985-89
(1983 dollars)

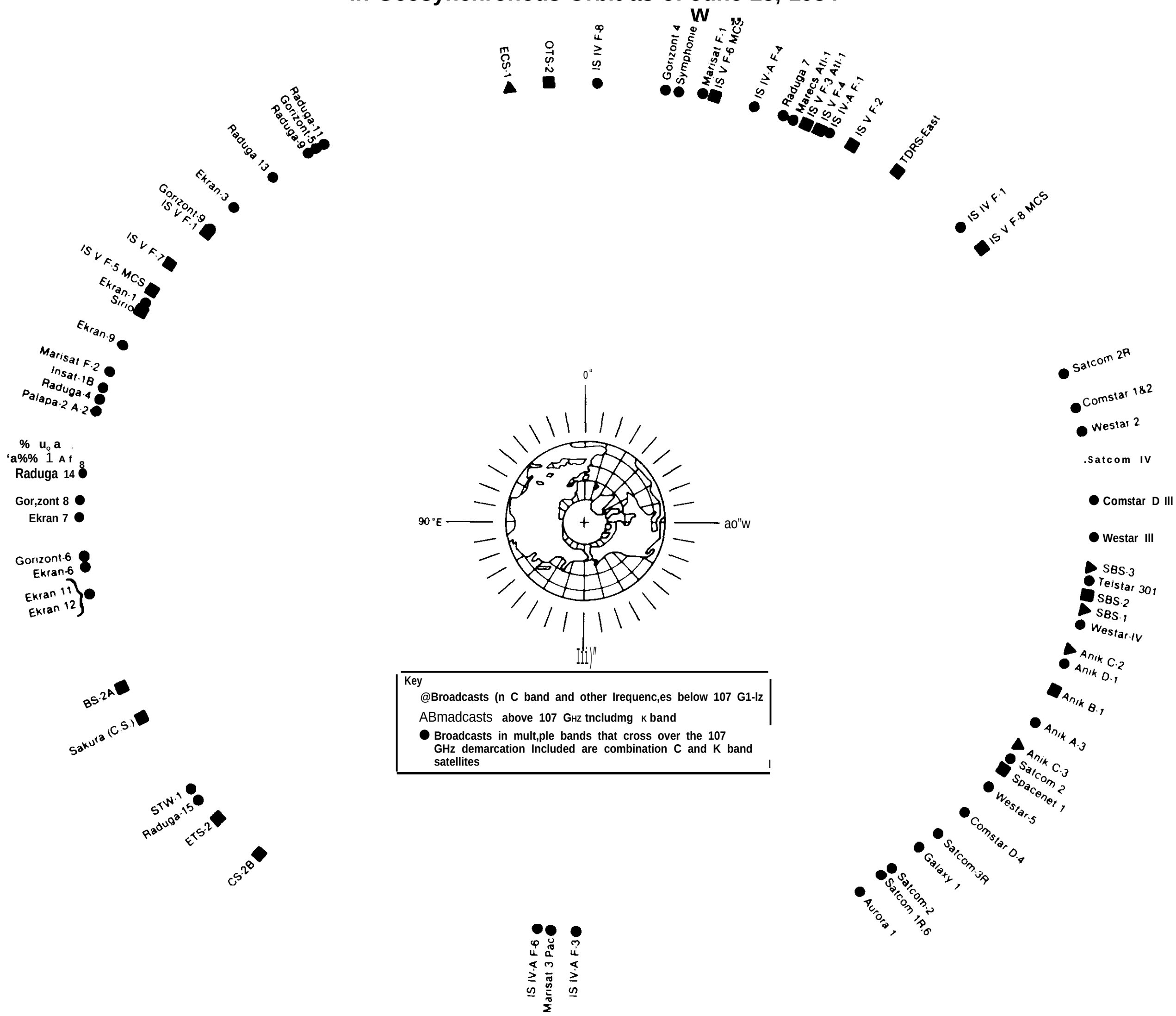


Total expenditures $5,892 million
Total launches (107)

[a]Does not include the Soviet Union.

SOURCE: Data from: R. Filep, A. Schnapf, and S. Fordyce, "World Communications Satellite Market-Characteristics and Forecast," prepared for NASA by Communications 21 Corp., NASA CR-166270, November 1963, p. 36.

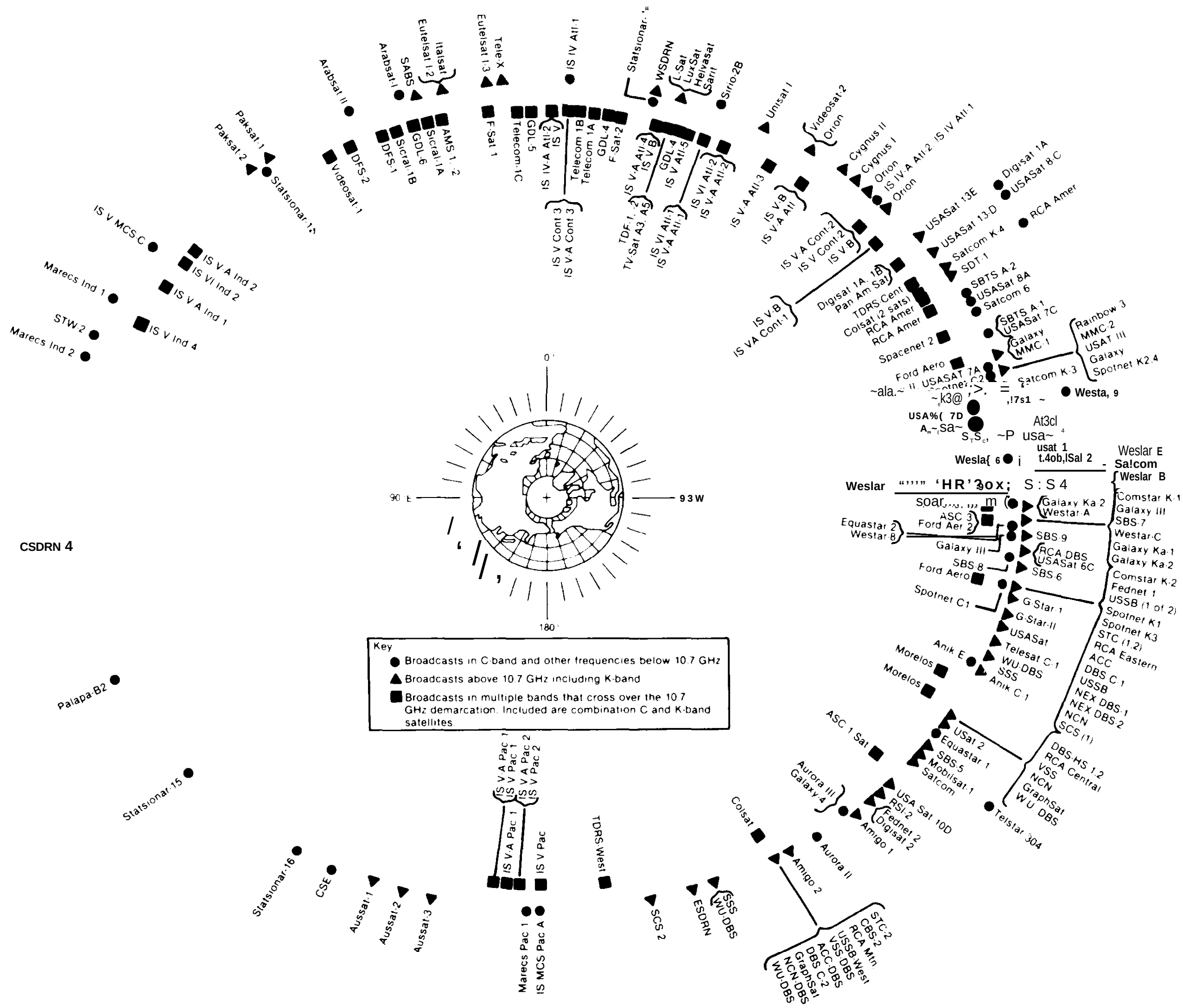
Figure 6B-3.–Locations of Commercial Communications Satellites in Geosynchronous Orbit as of June 25, 1984



NOTE:
1. IS refers to INTELSAT satellites.
2. The following are USSR satellite series: CSDRN, Ekran, ESDRN, Gorizont, Loutch, Potok, Prognoz, Raduga, Statsionar, Volna, WSDRN.

SOURCE: COMSAT, Communications Satellite Corporation Magazine, Washington, DC., 1984.

Figure 6B-4.—Locations of Commercial Communications Satellites in Geosynchronous Orbit Planned for as of June 25, 1984



NOTE:

1. IS refers to INTELSAT satellites.
2. The following are USSR satellite series: CSDRN, Ekran, ESDRN, Gorizont, Loutch, Potok, Prognoz, Raduga, Statsionar, Volna, WSDRN.
3. Multiple orbits are for legibility only. All geosynchronous satellites orbit at approximately 22,300 miles above the earth.

SOURCE: COMSAT, Communications Satellite Corporation Magazine, Washington, DC., 1984.

to follow its current Telecom series, but there are likely to be follow-on launches. The planned German, French, and British DBS launches have been delayed.[15]

A 1983 market analysis[16] also estimated that worldwide (excluding the Soviet Union), 107 commercial communications satellites, worth $5.9 billion, might be launched between 1986 and 1989, as shown in figure 66-2. U.S. firms are likely prime contractors for at least three-quarters of these 1986-1989 launches (as shown previously in table 6-7). Also projected are 171 launches worth $8.6 billion for the period 1990-2000. In another separate study for NASA, it is estimated that between 1983 and 1998, anywhere from 240 to 330 civilian communication satellites will be launched by the non-Communist world.[17] Again, as mentioned previously, launch projections in the 1990 s are highly uncertain.

In the more predictable decade of the 1980s, it is observed when comparing figure 66-1 and figure 6B-2 that investment in U.S. commercial communications satellites between 1986 and 1989 ($3. 19 billion) is projected nearly to double the investment (in constant 1983 dollars) during the previous cumulative 20 years ($1 .63 billion). In addition, the U.S. share of this worldwide investment would actually increase from 34 percent in the 1965-85 period to 54 percent in the 1986-89 period. The number of U.S. satellite transponders is expected to increase from 449 in December 1984 to as many as 883 by 1987.[18]

After several years of relativel y tight capacity, there is now surplus capacity, known as "transponder glut" in the industry.[19] This oversupply is likely to continue for the next 2 or 3 years at least because demand is expected to continue to lag supply as more satellites are launched in the near future. This may result in less launches actually taking place. According to a study by the FCC, carried out on a weekday afternoon in December 1983, only 54 percent of capacity on U.S. communication satellites was in use. Of the 14 satellites studied, 143 of 312 transponders were idle.[20] INTELSAT also has stated that its overall "load factor" has been only about 34 percent in recent years.[21] industry executives assert that this situation is cyclical and expect the excess capacity to disappear as they claim that a drop in service prices will eventually result in a dramatic rise in demand.[22] For several reasons, developing countries may also find it more feasible in the 1990s to rent INTELSAT or other satellite capacity than to install large complex terrestrial cable networks.[23]

The replacement market will continue to be a source of demand for satellites, even in the event of a slowdown in the demand for satellite communications, since satellite performance diminishes with age and satellites have typically been designed with lifetimes of 5 to 10 years[24] (see table 66-1, Design Life column). Table 66-2 lists estimated new and replacement commercial communications satellites scheduled for launch in the interval 1984 to the year 2000. The table demonstrates the significance of the replace-

Table 6B-2.—Estimated New and Replacement Communications Satellites Scheduied for Launch During 1984-2000

Year	New	Replacement
1984	11	10
1985	21	9
1986	21	7
1987	26	6
1988	20	9
1989	15	2
1990	8	4
1991	10	17
1992	8	13
1993	16	6
1994	10	10
1995	15	9
1996	13	4
1997	6	11
1998	8	8
1999	3	2
Total	211	127

SOURCE: R. Filep, A. Schnapf, and S. Fordyce, "World Communications Satellite Market—Characteristics and Forecast," prepared for NASA by Communications 21 Corp., NASA CR-168270, November 1963, p. 99.

15" W [Transmission Wave Tube] Problems Delay French, West German, DBS Programs," *Safe//ire News,* vol. 7, No. 43, Oct. 29, 1984, p. 5; "France Delays Launch of Direct Broadcast TDF-1Until 1986, " *Aviation Week and Space Technology,* Jan. 28, 1985, p. 93; Chris Bulloch, "New Satellites at Telecom 83–Spacecraft Builders Chase a Growing Market, " *Interavia,* January 1984, p. 77,

16Filep, Schnapf, and Fordyce, op. cit.

17Outside Users payload Model, prepared by Battelle Columbus Laboratories for NASA, NASW-3381, June 1983.

18Shaw, op. cit., p. 54, Filep, Schnapf, and Fordyce, op. cit.

19*The New york Times,* Op. cit.

20Ibid. See also "Quarterly Transponder Report of C-band and Ku-band Communication-Satellite Space Stations" by Charles C. Magin, Federal Communications Commission Field Operations Bureau, Sept. 28, 1984 and "FCC's Transponder Loading Report Continues to Show Wide Disparities in Usage, " *Satellite News,* Washington, DC, vol. 7, No. 45, Nov. 12, 1984, p. 1.

21 Chris Bulloch, "INTELSAT Builds Its Defenses Against Competition, *Interavia,* October 1984.

22Some industry groups contend that by the end of the 1980s, the supply of transponders may not keep pace with demand. ITT forecasts 1,37o transponders will be needed in 1990 and 3,594 in 2000. Western Union independently arrived at the numbers 1,140 transponders required in 1990 and 2,779 by 2000.

23This contrasts with the situation in developed countries which already have terrestrial networks of copper cable and microwave in place and also have many other available routes such as rail rights-of-way in which to lay fiber optic cable.

24Improvements in solar cell, battery, stationkeeping, and microwave amplification technology have Increased satellite lifetimes from 1.5 to 10 years in several cases. (Pollack and Weiss, op. cit.)

ment market, which represents over one-third of total estimated launches during this period.

Satellite life and therefore replacement interval is, however, subject to substantial uncertainty, Current generation satellites typically have estimated lifetimes of about **7** years, but experience with satellites to date and recent advances have led to estimates of increased life for satellites. RCA American Communications, for instance, recently asked the FCC to approve design modifications on its Satcom VI satellite that would increase its design life from 10 to 12 years .25

Satellite Suppliers

U.S. Firms

U.S. firms have dominated the international satellite market, **All U.S.** communications satellites thus far have been U.S.-built, and few, if any, of those now planned are likely to be foreign-built.[26] Table 6-7 previously listed the prime contractors for commercial satellites for the periods 1965-83 and 1984-89; U.S. dominance is evident, but foreign activity is increasing, The large U.S. market share in commercial satellite prime contracts was shown previously in table 6-6 with the United States capturing over 90 percent of the prime contracts from 1965 to 1983. It should be noted that in the future (1 984 through 1989) prime contracts will increasingly reside with the purchaser. It was also seen in table 6-6 that U.S. firms have been the prime contractors on all INTELSAT satellites, though models IV, V, and VI have had certain subsystems subcontracted to European and Japanese firms. For example, the INTELSAT VI contract, while going to Hughes Aircraft, involved subcontracts to non-U. S. firms totaling 21 percent of the contract value, as shown in table 6B-3.

The Indonesian, Australian, Indian, and Mexican national satellites have been or will be mostly or completely U.S.-built. Even where the U.S. firm is not the prime contractor, U.S. suppliers often play a key part-this is the case with the Brazilian, Arab League, and Japanese satellites.

Three U.S. firms dominate the civilian communication satellite market—Hughes Aircraft, Ford Aerospace, and RCA Astro-Electronics—as seen in table 6-7.27 Th_e largest supplier is Hughes Aircrafi, Which ‘n addition to providing satellites for several U.S. systems, has also sold satellites to Canada, Indonesia, Australia, and Mexico. Hughes won the INTELSAT contract to build at least the first five INTELSAT Vi-class satellites. That contract is worth $750 million and could rise to $1.3 billion. Estimated satellite sales (civilian and military) for 1983 were $1 billion, up from $715 million in 1982. The backlog of orders in 1983 was approximately $2 billion, half of which was for civilian satellites.[28] Approximately 8,000 Hughes employees work on space programs.

RCA Astro-Electronics estimated its satellite sales to be $240 million in 1983, but this figure includes Government-purchased, noncom munications satellites. The firm projects annual sales of $400 million by 1988 and has a current backlog of approximately $992 million .29 RCA employs 800 people on space programs.

Ford Aerospace & Communications has had contracts worth about $600 million to build 15 INTELSAT V and V-A satellites. The company's recent annual sales of civilian communications satellites has been in the range of $150 million. Ford has joined its competitors, Hughes and RCA, in forming its own satellite communications service subsidiary to buy and operate some of its equipment. The Ford Aerospace Satellite Services Corp. has applied with the FCC to launch three large "Fordsat" satellites each with 24 C-band and 24 Ku-band transponders.[30]

Table 6B-3.—INTELSAT VI: Subcontracts Let by the Prime Contractor Hughes Aircraft

Participant	Millions (Us. $)	Percent of tot=l contract value
United Kingdom:		
British Aerospace	32.4	4.8
France:		
Thomson-CSF	24.8	3.7
Germany:		
MBB	18.5	2.8
Selenia	24.4	3.6
Japan:		
NEC	22.6	3.4
Canada:		
Spar.	18.0	2.7
Total	$140.7	21 .0 "/0

SOURCE: R. FileP, A. Schnapf, and S. Fordyce, "World Communications Satellite Market—Characteristics and Forecast," prepared for NASA by Communications 21 Corp., NASA CR-168270, November 1983, p. 101.

25 The improvement has come primarily from the substitution of a new Upper stage, which will allow a larger amount of stationkeeping fuel (hydrazine) to be transported (*Satellite* News, Apr. 23, 1984, p. 1). Responsible administrations are moving their retired geosynchronous satellites into higher orbits to avoid the possibility of an orbit collision with an operating satellite. The orbital decay of these supergeosynchronous orbits is estimated at only 1 meter per year (Personal communication, Walter Morgan, Communications Center, December 1984)

26 A possible exception cou ld be in the DES market, where i n at least one case, a European consortium, Eurosatellite (led by Aerospatiale of France and MBB of West Germany) has teamed with General Electric of the United States to offer a satellite to that of one of the U.S. DBS firms. (See Chris Bulloch, "Aerospatiale and MBB Found a New Satellite Dynasty," *Interavia*, May 1984, p. 465.)

27 They are also large military satellite commu n ications contractors.

28 Chris Bulloch, "Communications Satellite Prospects: Competition Sharpens Between the 'Big Three' U .S Builders, ' *Interavia*, vol. 38, October 1983, p. 1111-1113

29 Ibid.

30 Bu l loch , "New Satellites at Telecom '83, " op. cit.

Foreign Firms

The major foreign firms building communication satellites and subsystems were indicated in tables 6-7 and 6B-3. One possible competitor to the big three U.S. firms appears to be the Eurosatellite consortium, made up of Aerospatiale (France), Compagnie Generale d'Electricity (France), MBB/ERNO (West Germany), ANT-Nachtrichten (successor in the space flight field to West Germany's AEG), and ETCA (Belgium). This consortium is not only offering a DBS satellite to U.S. firms, but may attempt to sell a low-capacity C-band satellite to INTELSAT for "thin-route" use over the Indian and Pacific Oceans. Two satellite consortia, which include West European firms, have been active in bidding on the second-generation INMARSAT system—namely, British Aerospace Dynamics Group/Hughes Aircraft Co,; and Marconi Space Systems Ltd./Ford Aerospace & Communications Corp. /Aerospatiale.[31]

The major communication satellite firms of Japan have been MELCO (Mitsubishi Electric Co.) and Toshiba, With assistance from Ford Aerospace, MELCO built the current CS-2A and CS-2B satellites. With help from General Electric, Toshiba is building the BS-2A and BS-2B direct broadcast satellites. Although the CS-2A is the world's first operational civilian communication satellite using the Ka band, it is a relatively small satellite with limited capacity: it is not likely to be offered for export. At some point in time, however, future generations of heavier Japanese satellites will probably be able to enter the export market.

International Competitive Factors in the World Satellite Market

In general, it seems likely that those countries or groups of countries that have invested substantial public resources in building industries capable of producing communication satellites will buy their satellites at home if they can,[32] This has been the case previously as shown in table 6-6. In the general export market and in the U.S. domestic market (the world's largest), U.S. firms will probably continue to dominate, based on their performance to date, although there are no trade barriers to the import of civilian communications satellites.

Inroads into this U.S. dominance might occur if foreign governments continue their heavy subsidization of satellite communications research and development and neither the U.S. Government nor U.S. private firms develop technology desired by those who buy and operate satellites in the 1990s,

[31] *Space Business News*, Apr. 23, 1984, p, 2; and Bulloch, "New Satellites at Telecom '83, " op. cit.

[32] This Commitment to their own prime contractors may nevertheless involve continued reliance on technical assistance or components from U.S. satellite manufacturers,

Earth Station Equipment Suppliers

The major equipment components which comprise Earth stations can be summarized by the following:

1. antenna and tracking system;
2. high power and low noise amplifiers;
3. ground communications equipment;
4. multiplex equipment (analog or digital); and
5. ancillary and support equipment (air-conditioning, power supplies, controls, etc,)33

Because U.S. Department of Commerce statistics do not permit easy identification of space-related telecommunications equipment, even the current size of this market is difficult to estimate. In 1981 it was estimated that between 1981 and 1985 the world market for Earth station equipment would total approximately $2.2 billion (in 1984 dollars). [34] The estimate for the period 1986-2000 was over $19 billion (in 1984 dollars) as shown in table 6B-4 which disaggregates

[33] Eloise Jensen, Tracey Harbaugh, Kenneth Telesca, and lames Mahoney, "Sector Study–Satellite Earth Stat ions," The Export-Import Bank, Washington, DC, June 1984.

[34] "Task 11 Report Planning Assistance for the 30/20 GHz Program: Worldwide Satellite Market Demand Forecast, " Western Union, NASA Report No. 1-4-W-I -TH, June 19, 1981.

Table 6B-4.—Satellite Earth Station Market Forecast (millions of 1984 U.S. dollars)

	1986.90	1991-2000	Total
North America:			
INTELSAT	11	46	57
Domestic	1,414	5,696	7,110
South America:			
INTELSAT	124	469	592
Domestic	14	121	135
Europe:			
INTELSAT	78	276	354
Domestic	681	2,511	3,192
Africa:			
INTELSAT	416	976	1,393
Domestic	5	36	40
Asia:			
INTELSAT	164	690	874
Domestic	608	4,310	4,918
Oceania:			
INTELSAT	35	129	164
Domestic	48	134	181
Totals:			
INTELSAT	846	2,586	3,433
Domestic	2,768	12,608	15,576

SOURCE: Derived from: "Task 11 Report Planning Assistance for the 30/20 GHz Program: Worldwide Satellite Market Demand Forecast," Western Union, NASA Report No. I-4-W-1-T11, June 19, 1981, pp. 3-91. Dollars converted to 1984 values.

by world region and **INTELSAT versus domestic systems.**

Several standards for Earth stations operating in conjunction with INTELSAT have been established with Standard A and Standard B being the most common. The features and differences of these INTELSAT station types are listed in table 6B-5.[35] Figure B-5 shows how typical ground stations costs vary for hardware and technical expertise for differing sizes of antenna.

Unlike the satellite manufacturing industry, which is dominated by three U.S. firms, the ground station industry has many firms in the United States and several prominent foreign firms as well . The Earth station market is large and growing, there are many suppliers in the international arena, and competition among them is intense. Price, rather than any specific technological advantage, is often the deciding factor in contract awards. The principal worldwide suppliers of satellite Earth stations and the station types they specialize in are listed in table 6B-6.[36]

Company profiles of some of the major satellite Earth station suppliers are given in table 6B-7. No one U.S. company produces all of the subsystems required for a significantly sized ground station; hence, numerous individual vendors may in fact be involved in a typical station project. Often the prime contractor will be a company with extensive background in microwave or antenna technology or in the actual communications technology.[37] For examnple, TIW specializes

[35] Jensen, et al, op cit; and Committee Print — United States Civilian Space Programs, vol II Applications Satellites Subcommittee on Space Science and Applications of the Committee on Science and Technology, U S. House of Representatives, May 1981, p. 35

[36] Note that, 'small'' station in this table refers to a Standard Z station which carries a 5- to 11-meter antenna The small commercial and "backyard" station (in the 1- to 2-meter size range) could thus be considered a very small, mini, or microstation The number of suppliers of these very small stations is substantial and increasing rapidly and are thus not specifically listed in the table

[37] Jensen et al, op cit

Table 6B-6.—Major Worldwide Suppliers of Satellite Earth Stations

	Station type[a]		
	Small	Medium	Large
United States:			
GTE International System Corp.	X	X	X
ITT Space[b]	X	X	X
TIW[c]		X	X
Harris Corp.	X	X	X
Scientific Atlanta.	X	X	X
GE[d]			X
M/A Communications Corp.	X		
Andrew Corp.	X		
Satellite Transmission System, Inc.	X		
Aydin	X	X	
Microdyne Corp.	X		
Amplica	X		
Satellite America	X		
NETCOM-TES	X		
Japan:			
NEC (Nippon Electric Co.)	X	X	X
Mitsubishi	X	X	X
France:			
Alcatel Thomson/Telspace.	X	X	X
Thomson-CSF.	X	X	X
United Kingdom:			
Marconi	X	X	X
West Germany:			
Siemens	X	X	X
ANT Telecommunications	X	X	X
MBB	X	X	X
Italy:			
STS	X	X	X

[a] The small, medium, and large station types are roughly similar to INTELSAT standard type Z, B, and A size stations respectively.
[b] ITT, an early competitor in the large Earth station market, is now withdrawing from this market
[c] TIW, previously a major supplier of Earth station antennas, is now penetrating the main contractor market.
[d] GE supplies LANDSAT type earth stations only

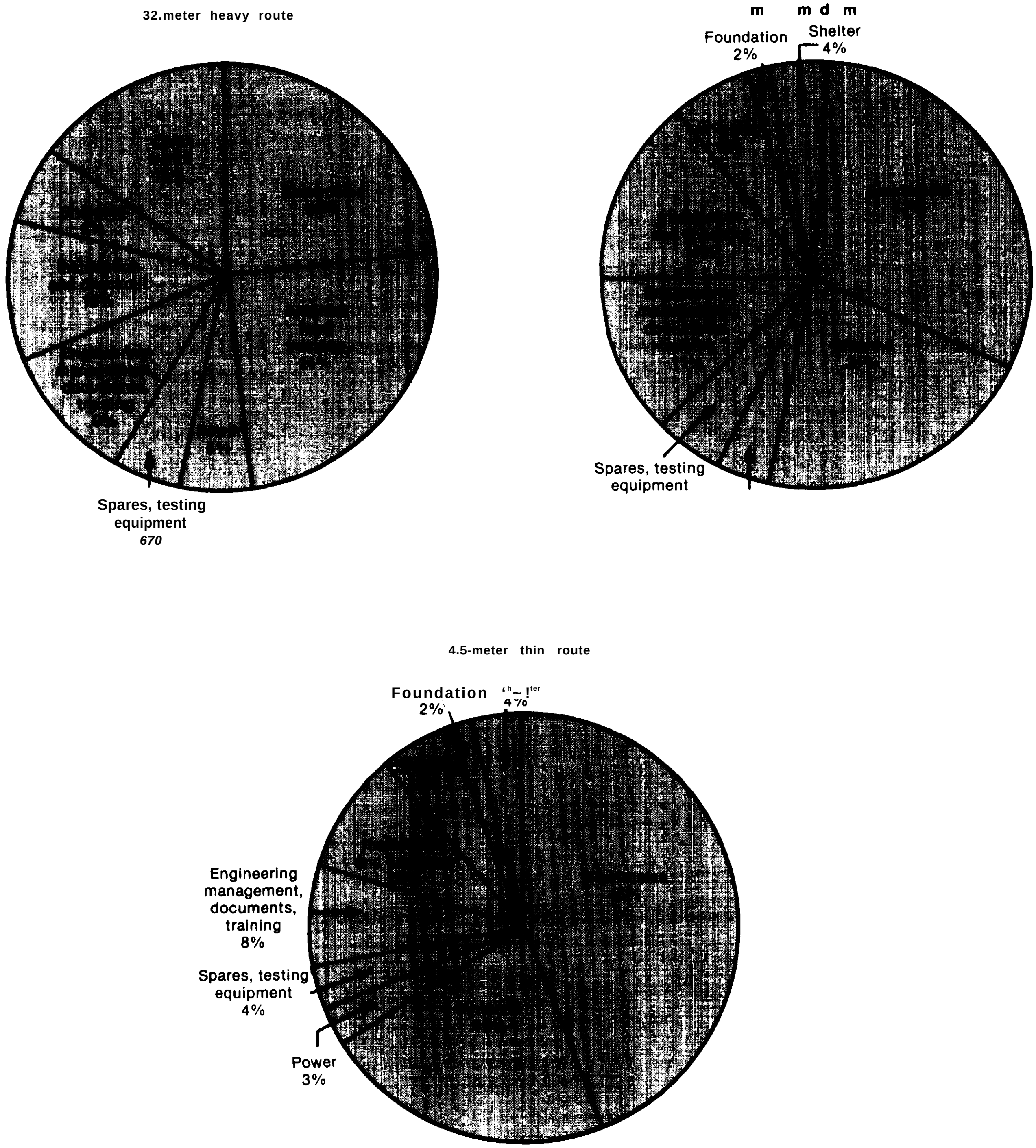
SOURCES: E. Jensen, et al , "Sector Study-Satellite Earth Stations," The Export. Import Bank, Washington, DC, June 1984; and Chris Bulloch and Paul W. Rubin, "Satellite Telecommunications-The Ground Segment Grows," *Interavia*, November 1984, pp. 1231-1235

Table 6B-5.—INTELSAT Earth Station Standards

Earth station standard	Antenna size in meters	Types of service	Frequency band (G Hz) uplink/downlink
A	26-32.5	International voice, data, TV, IBS	6/4
B	10-13	International voice, data, TV, IBS	6/4
c	17.4-38	International voice, data, TV, IBS	14/1 1
Dl"	5	VISTA (International or Domestic)	6/4
D2	11	VISTA (International or Domestic)	6/4
El	3.5-4.5	IBS (K band)	14/11 &. 14/12
E2	5.5	IBS (K band)	14/1 1 & 14/12
E3	8-10	IBS (K band)	14/1 1 & 14/12
F1	4.5-5	IBS (C band)	614
F2	7.5-8	IBS (C band)	6/4
F3	9-10	IBS (C band)	6/4
G	0.8-12	INTELNET, international TV, etc.	*6/4 & 14/11*
z	4.5-18.3	Domestic voice, TV, data	6/4 & 14/11

SOURCE: INTELSAT Report 1984-1985, Washington, DC, Mar. 31, 1985, p. 17.

Figure 6B-5.—Typical Ground Station Costs for Differing Antenna Sizes



SOURCE: Ford Aerospace and Communications, 1981.

in microwave and radar antenna systems, whereas GTE **specializes** in communications technology. Earth station technology was pioneered by several U.S. firms. The maturing of the technology, however, has marked the emergence of non-U.S. S. competitors who have successfully penetrated the market.

Early dominance by U.S. suppliers of large Earth stations has shifted to dominance by Japanese suppliers.

Table 6B-7.—Major Satellite Earth Station Suppliers-Company Profiles

Company, country	Origin	Ownership	Major business (products)	Performance	Comments
1, General Telephone & Electromcs Corp., U.S.A. (GTE)	Created as partnership in 1918. Incorporated in 1920 as Associated Telephone Utihties. (Reorganized in 1936 as General Telephone Corp.)	Private	GTE is the parent company of more than 60 communications, products, research, and serwce subsidiaries operating in 39 States & 19 foreign countries. Provides many types of communications services & the GTE products group produce products ranging from complete communications systems & telephone instruments to TV sets & lighting products.	*1982* Revenue & sales, 12,066 M $ Communications products, 1,614 M $ Net income, 550 M $	Well-positioned in ground station market as they are one of the few full-line telecommunications companies,
2. Harris, U.S.A.	Incorporated in 1926	Private	Information systems, communications equipment including two-way radios, microwave & lightwave transmission equipment, Earth stations & antennas for satellite communication, auxiliary telephone products, & turn-key telecommunications networks.	*1983* Total sales, 1,424 M $ Information systems, 319 M $ Communications products, 425 M $ Net income, 27 M $	Satellite-related revenues in 1983 were about $350 M. It has a wide breadth of products m Its Earth station line.
3. ITT, U.S.A.		Private	Diversified, principally in telecommunications-transmission switching & subscriber systems. Has 45 major R&D & engineering centers in 24 countries. In 1982 ITT operated plants & performed business in about 100 countries.	1982 Total sales, 15,958 M $ Telecommunications sales, 6,375 M $ Net income, 703 M $	Also involved in insurance/financial services and natural resources.
4. Scientific Atlanta, U.S.A.	Organized in 1951.	Prwate	Designs, manufactures, & markets commercial electroruc signal-generating and receiving equipment. Sales made directly to foreign purchasers constituted from 13 to 17% of the company's total sales in recent years.	1983 Total sales, 327 M $ Communications products, 205 M $ Net income, 0.37 M $	The formation of a European marketing joint venture with PLESSY should have given Scientific-Atlanta better access to the U.K. & Common Market communications markets—however, it was ended in Nov. 1984.
5 TIW, U .5A.	Until July 1983, TIW Systems Inc. was a wholly owned subsidiary of TIW Systems Ltd. In July 1983, Visionics Corp. acquired the shares of TIW Systems Ltd. and effected a reorganization resulting in two subsidiaries wholly owned by Visiomcs Corp.	Private	Design, fabrication, & installation of large-diameter antennas	*1983* Contract revenue, 9.8 M $ Net income, O 38 M $	A world leader in design and construction of large steerable antenna systems. TIW is now attempting to penetrate the prime contractor market for Earth stations

Table 6B-7.—Major Satellite Earth Station Suppliers-Company Profiles—Continued

Company, country	Origin	Ownership	Major business (Products)	Perfnrm2nr0	Comments
6. NEC, Japan	Began as a partnership in 1848. Incorporated in Japan m 1899	Private	Leading Japanese maker of telecommunications, electronic, & related equipment. In 1982 Government-owned NTT & Government agencies accounted tor 18'%0 of sales; Commercial 49%, and overseas 33%. Company has 42 major plants in Japan & 18 overseas plants, R&D labs are located near Tokyo.	***1982*** Total sales, 4,872 M $ Telecommunications sales, 1,461 M $ Employees, 69,000 Sales/employee, $70,546	Sales distribution by product line 1982 Elec. Computers & Industrial Elec. Equipment (23%), Communications equipment (37'Yo), Electron Devices *(24%),* Home Electronics (12%), Other (4%).
7. Mitsubishi, Japan	Founded in 1870 as a small shippmg company. Later incorporated	Private	Diversified, Fuels, metals, machinery, foods, chemicals, & textiles. Its communications products exist in its machineries group. Has a worldwide network of offices & offers a variety of products & services.	***1983*** Total sales, 65,346 M $ Net Income, 109 M $ Machinery, 13,893 M $ EXpOrtS, 12,062 M $	Many of the company's overseas projects are undertaken in partnership with local interests
8 Siemens, A, G., West Germany	Founded In 1847 by Werner Siemens. Reorganized as a stock corporation in 1897.	**Private**	Diversified telecommunications: Data Systems, Electromc Components, Safety & Securty Systems, Electrical Installations. Sales outside of Germany accounted for 55% of total sales in 1982. Almost one-half of its international business is m Western Europe,	***1982*** Total sales, 16,527 M $ Telecommunications sales, 4,627 M $ Export sales, (all categories), 4,938 M $ Net income, 272.6 M $ Employees, 324,000 Sales/employee, $51,009	**Sir?mens & ItS subsidiaries are the largest electrical company in West Germany**
9. The Thomson Group, France (Thomson-CSF and Thomson-Brandt)	Group founded m 1893 as Compagnie Francaise Thomson-Houston, Thomson-Brandt & CSF merged in 1968. Nationalized in early 1982.	**French Government**	CSF-Dwerslfied Telecommumcatlons products: transmitters, receivers, microwave, fiber optics, etc. Brandt-wire & cables, CSF is active in over 100 countries with manufacturing and/or commercial subsidiaries & representatwe offices. Thomson Corp. of America & seven other major subsidiaries are located m the U.S.	*CSF* ***1981*** Total sales, 4,363 M $ Telecommunications sales, 2,574 M $ Net income, 12 M $ Employees, 82,500 Sales/employee, $52,885	Thomson-CSF IS a world leader in electronic systems & equipment. Is a major subcontractor to Hughes aircraft for supplying electronics equipment for five INTELSAT VI satellites. TELSPACE, CSF'S joint venture with the CGE group, has many larae Earth station contracts

SOURCES E Jensen, et al-, "Sector Study –Satelhte Earth Statlons, The Export-Import Bank, Washington DC June 1984, annual reports of the respective companies; and private communications with the companies Involved October-November 1984

For example, NEC of Japan is the single largest source of large (Standard A) INTELSAT Earth stations. Figure 6B-6 illustrates relative market shares of suppliers of INTELSAT Standard A and Standard B stations. Japanese companies supplied 41.4 percent of the A stations while U.S. companies supplied 29.0 percent. U.S. companies performed better with B stations, having a 46.7 percent share of the INTELSAT B stations while Japanese companies captured 37.1 percent. When considering all types of full-scale, nonmilitary Earth stations in the non-Communist world, NEC alone has 1,018 of the approximately 3,000 stations, or about a 34-percent share of the world market, as shown in table 6B-8.

Japanese Earth station suppliers are successful in a broad spectrum of enterprises. Satellite Business Systems (SBS) ordered Time Division Multiple Access (TDMA) modems from Fujitsu, Ltd., for its Earth stations. Japanese manufacturers have sold 130 RF terminals to SBS.[38] Satellite Television Corp., a subsidiary of COMSAT, selected Alcoa-NEC Communications Corp. and Toshiba Corp. as suppliers of home receivers for its planned direct broadcast service .39 Thus, despite Japan's limited experience i n manufacturing sophisticated communications satellites, its ground equipment firms compete very well in international markets .40 Market trends indicate an increasing demand for smaller Earth stations and a smaller market for the larger Earth stations. As the demand for small, direct-broadcast receivers and antennas grows, Japanese firms may increase their penetration of the U.S. market. Whether Japanese companies will achieve in this sector of consumer electronics what it did with television sets and video recorders remains to be seen [41]

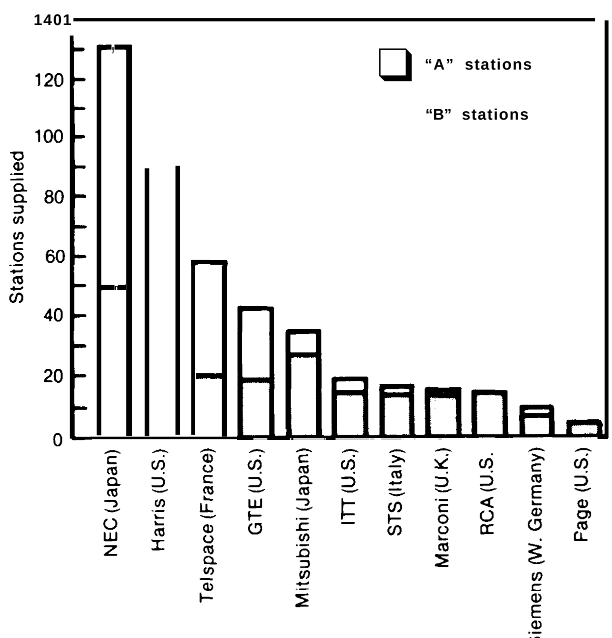
Developing countries are increasingly important markets for Earth station suppliers, since country authorities are placing a high priority on building and modernizing communications systems. However, in certain countries, as the number of sales within a country increases and the country develops technologically, ground station suppliers will be required to use an increasing percentage of local content.[42]

Table B-8.—NEC Satellite Earth Station Orders as of June 1984

INTELSAT Standard A Stations	59
INTELSAT Standard B Stations	39
Domestic—service stations using leased INTELSAT capacity	181
Domestic—service stations using other dedicated satellites	590
Domestic service stations in Japan	83
INMARSAT coastal and other stations	66
Total	1,018

SOURCE: Chris Bulloch and Paul W. Rubin, "Satellite Telecommunications—The Ground Segment Grows," *Interavia*, November 1984, p. 1234.

Figure 6B-6. —INTELSAT Satellite Earth Station Suppliers[a]



aAs of June 1982. From "Sector Study—Satellite Earth Stations." by E. Jensen, et al., The Export-Import Bank, Washington, DC, June 1984 and private communications with INTELSAT, Washington, DC, November 1984.

[38] Chris Bulloch and Paul W. Rubin, "Satellite Telecommunications—The Ground Segment Grows," *Interavia*, November 1984, pp. 1231-1235.

[39] "FCC Evaluating 15 Proposals for Satellite TV Broadcasting," *Aviation Week and Space Technology*, Mar. 12, 1984, p. 116.

[40] Bulloch, "Satellite Telecommunications—The Ground Segment Grows," op. cit.

[41] Sales of U.S. ground station equipment in Japan, however, has so far been minimal. Telecommunications policy in Japan is now undergoing changes that may permit private companies to supply telecommunications services and own telecommunications facilities which theoretically could make possible the sale of U.S. communications satellites and ground station equipment in Japan in the future. See for example: "New Trade Policy May Boost Japanese Imports of Satellites," *Aviation Week and Space Technology*, May 1984. "Hughes to Announce Extensive Joint Venture for Japanese DOMSAT System," Satellite *News*, Washington, DC, vol. 7, No. 37, Sept 17, 1984, p. 1; "Hughes to Study Japanese Telecommunications," *Aviation* Week and *Space Technology*, Sept. 24, 1984, p. 25; "Japan's Itoh Plans Hughes Satcom Buy," *Aviation Week and Space Technology*, Oct. 22, 1984, p. 30; "RCA Astro to Announce Japanese Satellite Venture With Sony; Ford Works With Mitsubishi," *Satellite News*, Washington, DC, vol. 7, No. 49, Dec. 10, 1984, John Burgess, "Japan's Phone Shake-Up May Profit U.S. Firms," *The Washington Post*, *Nov. 18*, 1984, p F 1; Susan Chira, "Nippon Telegraph Sale to Public is Backed," *The New York Times*, Dec. 14, 1984, p. D1

[42] Jensen, et al., op. cit.; and personal communications with Harris Corp. and Scientific Atlanta, December 1984 These requirements for technology transfer are becoming increasingly prevalent.

APPENDIX 6C.—INTELSAT AND INMARSAT MEMBERS: SIGNATORIES AND INVESTMENT SHARES

Country	Signatory	Investment share* percent
INTELSAT		
United States	Communications Satellite Corp...	23.09
United Kingdom	British Telecommunications	12.93
France	Governmentof France ...,	5.65
Japan	Kokusai Denshin Denwa Co. Ltd.	3.33
Germany, Federal Republic of	Ministry for Post and Telecommunication.	3.30
Australia	Overseas Telecommunications Commission	3.24
Saudi Arabia	Government ofSaudi Arabia	3.14
Brazil	Empri%a Brasileira de Telecomunica@es S.A.	3.04
Canada	Teleglobe Canada	2.98
Italy	Societ3 Telespazio.	2.15
Spain	Compall~ Telef6nica Nacional de Espafia	2.00
Mexico	Government of Mexico	1.82
United Arab Emirates	Ministry of Communications	1.74
Venezuela	Compah~Anofiima Nacional TelFfonos de Venezuela	1.42
Nigeria	Nigerian External Telecommunications Ltd.	1.33
Singapore	Telecommunication Authority of Singapore	1.30
Switzerland	Direction G<n~ralede l'Entreprisedes Postes, TEl@phoneset T~l&graphes Suisses	1.25
South Africa	Department of Posts and Telecommunications.	1.17
Argentina	Empresa Nacional de Telecomunicaciones	1.15
Netherlands	Government of the Kingdom of the Netherlands	1.06
India	Ministry of Communications	1.03
Iran, Islamic Republic of.	Telecommunication Co. oflran	1.02
Kuwait	The Ministry of Communications	1.01
Colombia	Empresa Nacional de Telecomunicaciones	1.00
Greece	Hellenic Telecommunications Organization S.A.	0.84
Korea, Republic of	Korea Telecommunication Authority	0.72
Belgium	R~giedes T61~graphes et des T61<phones	0.72
Philippines	Philippine Communications Satellite Corp.	0.65
Sweden	Swedish Telecommunications Administration	0.64
Portugal	Companhia Portuguese RSdio Marconi	0.63
Egypt	Government of the Arab Republic of Egypt	0.62
Peru	Empresa Nacionai de Telecomunicaciones del Peru	0.06
Chile	Empresa Nacional de Telecomunicaciones S.A.	0.58
Israel	Government of the State oflsrael	0.56
Oman	Sultanate of Oman	0.51
Thailand	Government of Thailand	0.49
Indonesia	Government of the Republic oflndonesia	0.48
Denmark	Generaldirektoratet for Post-og Telegrafvaesenet	0.42
New Zealand	Postmaster-General of New Zealand	0.40
Jamaica	Jamaica International Telecommunications Ltd.	0.04
Iraq	Government of the Republic oflraq	0.04

Country	Signatory	Investment share* percent
China, People's Republic of	Ministry of Posts and Telecommunications	0.39
Norway	Norwegian Telecommunications Administration.	0.39
Algeria	Government of Algeria	0.39
Kenya	Kenya Posts & Telecommunications Corp.	0.38
Pakistan	Government of Islamic Republic of Pakistan	0.37
Qatar	Government of the State of Qatar.	0.35
Ecuador	Instituto Ecuatoriano de Telecomunicaciones	0.35
Sudan	Governmentof Democratic Republic of Sudan	0.33
Yugoslavia	Yugoslav Posts, Telegraphs &Telephones.	0.32
Morocco	Government of Morocco	0.31
Austria	Governmentof Austria	0.30
Jordan	Governmentof the Hashemite Kingdom of)ordan	0.30
Zaire	Office National des Posteset Telecommunications du Zaire..	0.29
Ivory Coast	Governmentof the Republic oflvory Coast	0.29
Malaysia.	Telecommunications Department, Malaysia	0.25
Cameroon	Socid#des Td@communications Internationalesdu Cameroun	0.24
Turkey	Government of Turkey	0.23
Yemen Arab Republic.	Government of Yemen Arab Republic	0.22
Haiti	T61{communications d'Haiti S.A.	0.18
Iceland	Government oflceland.	0.18
Libya	Government of the Libyan Arab Republic	0,15
Ireland	Department of Posts and Telegraphs	0.13
Cyprus	Cyprus Telecommunications Authority	0.13
Syria	Government of the Syrian Arab Republic	0.13
Paraguay	Administration Nacional de Telecomunicaciones	0.12
Angola	Empr~sa Ptiblica de Telecomunica@es	0.11
Zambia.	Government of the Republic of Zambia	0.11
Bangladesh	Telegraph and Telephone Board of Bangladesh	0.10
Lebanon.	Government of Lebanon	0.10
Ethiopia	Telecommunications Service	
Mali	T61dcommunications Internationalesdu Mali	0.09
Finland.	General Directorate of Posts and Telecommunications	0.08
Bolivia	Empresa Nacional de Telecomunicaciones	0.08
Afghanistan	Ministry of Communications	0.05
Barbados	Cable and Wireless (West Indies) Ltd.	0.05
Burkina Faso	Officedes Postes et Td<communications de Burkina Faso	0.05
Central African Republic.	Government of the Central African Republic	0.05
Chad	Socid<des T61<communications Internationalesdu Tchad	0.05
Congo	Government of People's Republic of the Congo	0.05
Costa Rica	Instituto Costarricense de Electricidad	0.05
Dominican Republic	Compa;fi Dominican de TelFfonos	0.05
El Salvador.	Administration Nacional de Telecomunicaciones	0.05
Fiji	Fiji International Telecommunications Ltd.	0.05
Gabon	Soci<td des T41<communications Internationales	0.05
Ghana	Ministry of Transport and Communications	0.05
Guatemala	Empresa Guatemalteca de Telecomunicaciones	0.05
Guinea	Government of People's Revolutionary Republic of Guinea ..	0.05
Honduras.	Empresa Hondurefia de Telecomunicaciones	0.05
Liechtenstein	Government of the Principalityof Liechtenstein.	0.05

Country	Signatory	Investment share* percent
Luxembourg	Government of Luxembourg	0.05
Madagascar	Societe des Telecommunications Internationales	0.05
Mauritania	Government of Islamic Republic of Mauritania	0.05
Monaco	Government of the Principality of Monaco	0.05
Nicaragua	Compania Nicaraguense de Telecomunicaciones por Satelite	0.05
Niger	Government of the Republic of Niger	0.05
Panama	Intercontinental de Comunicaciones por Satelite, S.A.	0.05
Papua New Guinea	Post and Telecommunication Corp. of Papua New Guinea	0.05
Senegal	Government of the Republic of Senegal	0.05
Somalia	Ministry of Posts and Telecommunications	0.05
Sri Lanka	Government of Sri Lanka	0.05
Tanzania	Tanzania Posts and Telecommunications Corp.	0.05
Trinidad and Tobago	Trinidad and Tobago External Telecommunications Co. Ltd.	0.05
Tunisia	Administration for Post, Telegraph and Telephone	0.05
Uganda	Ministry of Power, Posts, and Telecommunications	0.05
Uruguay	Administration Nacional de Telecomunicaciones	0.05
Vatican City State	Government of the Vatican City State	0.05
Viet Nam	Direction Generaledes Postes et Telecommunications	0.05

*As of Mar. 1, 1984

SOURCE INTELSAT, Contribution of the Director General, MS-14 -6 E W/4/84, Mar. 19, 1984 (See Footnotes in Original). Certain name abbreviations and changes have been made by OTA.

INMARSAT		
United States	Communications Satellite Corp.	30.73
United Kingdom	British Telecommunications	14.55
Norway	Norwegian Telecommunications Administration	11.59
Japan	Kokusai Denshin Denwa Co., Ltd.	6.96
USSR	Morsviazsputnik	6.91
Canada	Teleglobe Canada	3.85
Denmark	Post and Telegraph Administration	2.47
Singapore	Telecommunication Authority of Singapore	2.39
Netherlands	Netherlands PTT Administration	2.28
Italy	Telespazio	1.94
Germany, Federal Republic of	Ministry for Port & Telecommunication	1.69
France	Direction Generale des Telecommunications	1.67
Greece	Helienic Telecommunications Organization	1.67
Kuwait	Ministry of Communications	1.17
Spain	Compafi;a Telefdnica Nacional de Espafia	1.17
Sweden	Swedish Telecommunications Administration	1.10
Australia	Overseas Telecommunications Commission	1.08
Brazil	Empresa Brasileira de Telecomunicacoes S.A,	0.97
India	Overseas Communications Service	0.97
Poland	Office of Maritime Economy	0.97
Saudi Arabia	Ministry of Posts, Telegraphs and Telephones	0.97
China	Beijing Marine Communications and Navigation Company.	0.72
Belgium	Regie des Telegraphes et des Telephones	0.34
Argentina	Empresa Nacional de Telecomunicaciones	0.30
Finland	General Directorate of Posts and Telecommunications of Finland	0.30

Country	Signatory	Investment share* percent
New Zealand	Post Office Headquarters	0.21
Bulgaria	Shipping Corp.	0.16
Portugal	Companhia Portuguese Radio Marconi	0.11
Egypt	National Telecommunications Organization	0.07
Liberia	Republic of Liberia	0.07
Philippines	Philippine Communications Satellite Corp.	0.07
United Arab Emirates	Ministry of Communications	0.07
Sri Lanka	Overseas Telecommunication Service	0.06
Algeria	Ministere des Postes et Teledcommunications	0.05
Chile	Empresa Nacionai de Telecomunicaciones S.A.	0.05
Gabon	Telecommunications Internationales Gabonaises	0.05
Iran.	Telecommunication Co. of Iran	0.05
Iraq	Republic of Iraq	0.05
Oman	Sultanate of Oman	0.05
Pakistan	Pakistan Telegraph and Telephone Department.	0.05
Tunisia	Republic of Tunisia	0.05

** Asot **Feb 6,** 1985.

APPENDIX 6D.–ARTICLE XIV AND OTHER EXCERPTS FROM THE INTELSAT AGREEMENT RELATING TO SPACE SEGMENT "FACILITIES SEPARATE FROM INTELSAT"

Agreement Relating to the International Telecommunications Satellite Organization "INTELSAT" May 19, 1971

Preamble

The States Parties to this Agreement,

Considering the principle set forth in Resolution 1721 (XVI) of the General Assembly of the United Nations that communication by means of satellites should be available to the nations of the world as soon as practicable on a global and nondiscriminatory basis,

Considering the relevant provisions of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, and in particular Article I, which states that outer space shall be used for the benefit and in the interests of all countries,

Noting that pursuant to the Agreement Establishing Interim Arrangements for a Global Commercial Communications Satellite System and the related Special Agreement, a global commercial telecommunications satellite system has been established,

Desiring to continue the development of this telecommunications satellite system with the aim of achieving a single global commercial telecommunications satellite system as part of an improved global telecommunications network which will provide expanded telecommunications services to all areas of the world and which will contribute to world peace and understanding,

Determined, to this end, to provide, for the benefit of all mankind, through the most advanced technology available, the most efficient and economic facilities possible consistent with the best and most equitable of the radio frequency spectrum and of orbital space,

Believing that satellite telecommunications should be organized in such a way as to permit all peoples to have access to the global satellite system and those States members of the International Telecommunication Union so wishing to invest in the system with consequent participation in the design, development, construction, including the provision of equipment,

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establishment, operation, maintenance, and ownership of the system,

Pursuant to the Agreement Establishing Interim Arrangements for a Global Commercial Communications Satellite System,

Agree as follows:

Article 1: Definitions

* * *

(k) "public telecommunications services" means fixed or mobile telecommunications services which can be provided by satellite and which are available for use by the public, such as telephony, telegraphy, telex, facsimile, data transmission, transmission of radio and television programs between approved earth stations having access to the INTELSAT space segment for further transmission to the public, and leased circuits for any of these purposes; but excluding those mobile services of a type not provided under the Interim Agreement and the Special Agreement prior to the opening for signature of this Agreement, which are provided through mobile stations operating directly to a satellite which is designed, in whole or in part, to provide services relating to the safety or flight control of aircraft or to aviation or maritime radio navigation;

(1) "Specialized telecommunications services" means telecommunications services which can be provided by satellite, other than those defined in paragraph (k) of this Article, including, but not limited to, radio navigation services, broadcasting satellite services for reception by the general public, space research services, meteorological services, and earth resources services;

* * *

Article XIV: Rights and Obligations of Members

(a) The Parties and Signatories shall exercise their rights and meet their obligations under this Agreement in a manner fully consistent with and in furtherance of the principles stated in the Preamble and other provisions of this Agreement.

(b) All Parties and all Signatories shall be allowed to attend and participate in all conferences and meetings, in which they are entitled to be represented in accordance with any provisions of this Agreement or the Operating Agreement, as well as in any other meeting called by or held under the auspices of INTELSAT, regardless of where they may take place. The executive organ shall ensure that arrangements with the host Party or Signatory for each such conference or meeting shall include a provision for the admission to the host country and sojourn for the duration of such conference or meeting, of representatives of all Signatories entitled to attend.

(c) To the extent that any Party or Signatory or person within the jurisdiction of a Party intends to establish, acquire or utilize space segment facilities separate from the INTELSAT space segment facilities to meet its domestic public telecommunications services requirements, such Party or Signatory, prior to the establishment, acquisition or utilization of such facilities, shall consult the Board of Governors, which shall express, in the form of recommendations, its findings regarding the technical compatibility of such facilities and their operation with the use of the radio frequency spectrum and orbital space by the existing or planned INTELSAT space segment.

(d) To the **extent that any party or Signatory or person within the jurisdiction of a Party intends individually or jointly to establish, acquire or utilize space segment facilities separate from the INTELSAT space segment facilities to meet its international public telecommunications services requirements, such Party or Signatory, prior to the establishment, acquisition or utilization of such facilities, shall furnish all** relevant information to and shall consult with the Assembly of Parties, through the Board of Governors, to ensure technical compatibility of such facilities and their operation with the use of the radio frequency spectrum and orbital space by the existing or planned INTELSAT space segment and to avoid significant economic harm to the global system of INTELSAT. Upon such consultation, the assembly of Parties, taking into account the advice of the Board of Governors, shall express, in the form of recommendations, its findings regarding the considerations set out in this paragraph, and further regarding the assurance that the provision or utilization of such facilities shall not prejudice the establishment of direct telecommunication links through the INTELSAT space segment among all the participants.

(e) To the extent that any Party or Signatory or person within the jurisdiction of a Party intends to establish, acquire or utilize space segment facilities separate from the INTELSAT space segment facilities to meet its specialized telecommunications services requirements, domestic or international, such Party or Signatory, prior to the establishment, acquisition or utilization of such facilities, shall furnish all relevant information to the Assembly of Parties, through the Board of Governors. The Assembly of Patties, taking into account the advice of the Board of Governors, shall express, in the form of recommendations, its findings regarding the technical compatibility of such facilities and their operation with the use of the radio frequency spectrum and orbital space by the existing or planned INTELSAT space segment.

(f) Recommendations by the Assembly of Parties or the Board of Governors pursuant to this Article shall be made within a period of six months from the date of commencing the procedures provided for in the foregoing paragraphs. An extraordinary meeting of the Assembly of Parties may be convened for this purpose.

(g) This Agreement shall not apply to the establishment, acquisition or utilization of space segment facilities separate from the INTELSAT space segment facilities solely for national security purposes.

SOURCE: U.S. Senate, Committee on Aeronautical and Space Sciences, "International Cooperation in Outer Space: A Symposium," Document 92-57, 92d Cong., 1st sess., 1971, pp. 609-637. Also available in recent undated INTELSAT print: INTELSAT, *The Agreement and the Operating Agreement*, Washington DC.