MARKET STRUCTURE AND INVESTMENT BEHAVIOR IN THE INTERNATIONAL TELECOMMUNICATIONS INDUSTRY

Thesis for the Degree of Ph. D.

MICHIGAN STATE UNIVERSITY

KENNETH BISHOP STANLEY

1971

This is to certify that the

thesis entitled

Market Structure and Investment Behavior
in the
International Telecommunications Industry

presented by

Kenneth Bishop Stanley

has been accepted towards fulfillment
of the requirements for

Ph. D. degree in Economics

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Date October 29, 1971

O-7639

ABSTRACT

MARKET STRUCTURE AND INVESTMENT BEHAVIOR IN THE INTERNATIONAL TELECOMMUNICATIONS INDUSTRY

By

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The international telecommunications industry provides an interesting case of the interaction of selected structural variables, investment behavior, and industry performance. The market is cartelized. Two firms, AT&T and Comsat, provide the two principal types of transmission facilities, submarine cables and satellites. Neither firm is in a position to choose between the two technologies in making an investment decision. Comsat is a Congressionally created monopoly for U.S. participation in the international satellite system and is restricted to the satellite technology. AT&T is the principal firm that provides cable facilities. AT&T is a customer, competitor, stockowner, and Board member of Comsat and provides communications services to final users. Comsat is generally precluded from direct access to the market and serves primarily as a common carriers' carrier. Both firms are regulated by the FCC and the allowable profits of each firm depend on its capital investment.

A number of implications about the existing market structure are presented; the primary one concerns the involvement of AT&T in Comsat. The objectives of the two firms are not always consistent. With a substantial investment in cables, AT&T's position as the major stockholder and Board member of Comsat creates a major conflict of interest. Comsat's ability to act independently on policy matters and decision making is restricted due to AT&T's direct representation in the company. As a result of the AT&T involvement and its role as the major lessee of satellite circuits, Comsat is essentially relegated to the role of a vertical affiliate of AT&T.

The investment policies of AT&T and Comsat are mainly based on corporate objectives rather than the attainment of an economically efficient international communications network. The basis of the AT&T policy is the maintenance of a 50/50 balance of cable and satellite circuits. This policy is aimed at maintaining the role of cables in international communications and preserving AT&T's dominant market position. The depreciation policy of AT&T, an integral part of investment, does not make adequate allowance for technological obsolescence and tends to result in a stockpile of potentially obsolete equipment. The Comsat investment policy is aimed at increasing the reliance of the international common carriers on satellites by displacing the relative need for cable circuits. Large capacity satellites with reportedly low capacity unit costs are launched. However, these costs are not necessarily synonomous with low unit operating costs.

The interaction of industry structure and investment behavior is examined through an analysis of the mix of facilities and their operation for transatlantic communication over the 1965-1970 period. The mix of facilities varied but older, relatively high cost cables were consistently utilized at high levels of capacity. The original, high cost satellites have been replaced by more advanced models with a consequent reduction in annual unit costs and increased productivity. However, these advanced facilities were not operated as intensively as the older cables and exhibited significant idle capacity. The older cables were simultaneously operated at capacity. In consequence, the benefits of technological advancements were partially nullified by the continued reliance on older cables.

The principal conclusion of the paper is the need for improvement in the performance of the international communications industry. A number of suggestions are advanced with a view toward improving the effectiveness of regulation in this industry, given the existing market structure. The emphasis is placed on improving the information base of the FCC. Additional suggestions are presented that deal with changes in the market structure in order to establish a different decision making framework and stimulate market incentives.

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Economics

1971

ACKNOWLEDGMENTS

I wish to express my appreciation to Dr. Harry M. Trebing, the committee chairman. He originally suggested international communications as a research topic and provided stimulating guidance and constructive criticism throughout the course of study.

The assistance of several individuals and organizations must also be acknowledged. The Institute of Public Utilities, Graduate School of Business Administration, Michigan State University, provided a research grant that enabled me to conduct personal interviews and discussions with various people at AT&T and Comsat. I am also indebted to the people at AT&T and Comsat who discussed numerous aspects of international communications with me and supplied information. The remaining members of the thesis committee were very helpful. Mr. Asher H. Ende, Deputy Chief, Common Carrier Bureau, FCC, willingly shared his knowledge of international communications and asked many probing questions. Dr. David D. Martin, Chief Economist, Senate Anti-Trust and Monopoly Subcommittee, provided helpful suggestions on several of the problems encountered. Dr. Warren J. Samuels, by questioning the topic in its initial stages, was helpful in defining the problem to be studied and then offered several constructive suggestions as the study progressed.

Finally, I owe a special debt of gratitude to my wife, Linda, who, at various times, typed drafts, helped edit the drafts, and, above all, was a patient listener.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION TO THE PROBLEM IN TRANS-ATLANTIC TELECOMMUNICATIONS

In those industries designated as "public utilities," government regulation is exercised in order to promote certain objectives. The regulation of public utilities serves to protect the public from the abuses that may result from monopolistic behavior. Among the goals associated with public policy toward regulated industries are the following:

1. promotion of resource allocation between regulated industries and other sectors of the economy in a manner that is consistent with consumer wants,
2. promotion of the maximum efficient use of existing facilities through high load factors thereby realizing potential economies of scale,
3. assurance of adequate service at reasonable rates,
4. prevention of undue price discrimination to alleviate any adverse effects associated with a redistribution of income,
5. minimization of the effects of negative externalities, and
6. assurance of adequate consideration to non-market objectives.

System optimization is an integral part of the task of regulation as a means of achieving these goals. It is part of an overall planning function to insure the provision of adequate facilities necessary to satisfy demand requirements at the lowest cost in a manner that is consistent with the simultaneous accomplishment of specified objectives. System optimization involves planning the total commitment of resources for an integrated network in a manner that insures coordinated development and operation of separate systems such that degeneration in performance and wasteful redundancy are avoided. Increments to existing capacity are not the sole concern. System optimization encompasses existing facilities as well as planned additions to capacity. Investment decisions are based on inherited capital and planning into the future on the need for additional facilities, the amount of expenditure, the type of facilities to be added, the timing of additions, and the retirement of existing facilities. These decisions must be coordinated in light of existing capacity and changing conditions if policy objectives are to be promoted. System optimization is thus a continuous process of partial adaptation to changing circumstances.

In addition to such economic criteria as resource allocation and the efficient use of facilities, system optimization requires an appropriate consideration of a number of non-market objectives. The inclusion of these non-market considerations in the decision making process, along with the other goals, requires a balancing of multiple objectives. The maximization of an individual objective is not necessarily consistent with the promotion of an optimal system because every adjustment to satisfy one objective is, a priori, non-optimal with respect to one or more other criteria. The problem is one of joint maximization. For instance, satisfaction of the marginal conditions required for Pareto optimality will result in an optimal system on the limited basis of economic criteria. However, to the extent that other criteria are relevant, system optimization cannot be based solely on the objective of economic efficiency. The introduction of these non-economic criteria will, therefore, involve second best type solutions. In consequence, the determination of system optimization, at any point in time and over time, is a complex undertaking that involves a judicious balancing of multiple objectives. Enhancing the difficulty further is the specification of the objective function, i.e., denoting the relevant criteria and the relative priority of each goal.

Theoretically, in the absence of externalities, firms in a perfectly competitive market structure tend to move in the direction of optimum production in accord with consumer wants. Since no single firm can influence price or output, market pressures are pervasive. Each firm is under pressure to produce at the minimum attainable unit cost and market price tends to equal this cost. Industry output is at the maximum level that can be sold at a price covering the minimum cost. Competitive pressures force the firms to adopt cost reducing methods of production, remove obsolete equipment, and add to capacity with the best available capital alternative. Failure of a firm to respond to market signals may cause bankruptcy if price reductions do not allow a firm to recover the capital invested in older equipment. In short, there is a tendency toward an optimum number of firms supplying output at minimum costs in a manner that is consistent with consumer desires. Thus, market forces promote efficient resource utilization without the need for outside regulation.

Public utility industries, on the other hand, are typically characterized by a small number of firms, either monopolistic or highly oligopolistic. The possibilities for effective competition are thereby limited. The lack of market pressures and the need for coordination of facilities among the firms within an industry cause system optimization to be a general problem in regulated industries. In the absence of compelling market forces, regulated firms do not operate under the same market pressures that lead to an efficient utilization of resources as in the competitive model. It cannot be presumed, a priori, that the private objectives of such firms will be congruent with the general policy goals. For example, a public utility operates under some profit motive. As noted by Averch and Johnson,[1] the profit motive under a regulatory constraint on the rate of return produces an incentive for unwarranted capital expansion in order to camouflage excessive profits. Further, expansion into noncompensatory markets may also be encouraged as a means of masking monopoly profits. Resource allocation becomes distorted and facilities are not efficiently utilized. Hence, there is a need for governmental regulation of these industries to monitor behavior and prevent abuses.

Transatlantic Telecommunications as Related to System Optimization

Transatlantic telecommunications provides an excellent example of the potential difficulties encountered in attaining an optimal, integrated communication network. The environment is one of continual change. The demand for communications services is growing at a high annual rate. The technology is improving at a rapid pace. New communications markets are developing. In this dynamic setting, factors are present that may act as obstacles to the achievement of system optimization. First, the market structure is characterized by many imperfections, both structural and institutional. The two primary firms, the American Telephone and Telegraph Company (AT&T) and the

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[1]Harvey Averch and Leland Johnson, "The Firm Under Regulatory Constraint," The American Economic Review, LII (1962).

Communications Satellite Corporation (Comsat), coexist in a unique relationship. Second, two communication mediums, satellite and cable, form the principal elements of the communication network. Both systems are very capital intensive and relatively inflexible once investments have been installed. Once cables and satellites are installed, many other decisions, such as the level of annual costs or the division of output, are largely determined. Third, Comsat and AT&T are regulated and, therefore, subject to the tendencies that are peculiar to such firms. Finally, numerous policy objectives are associated with the integrated telecommunication network. These objectives range from economic efficiency considerations, national defense and service reliability to rapid development of satellite communication, per se, as a national goal. These goals may not be entirely consistent with each other and, therefore, relative priorities affect the composition of the communication network.

In an endeavor to meet the various policy objectives, as well as satisfy their own goals, AT&T and Comsat make continuous alterations in the operation and capacity of their communication systems in an attempt to adapt to conditions in a changing environment. However, each firm may be subject to systematic biases or employ policies that hinder movement in the direction of an optimal, integrated transatlantic telecommunications network.

In light of the foregoing observations, an inquiry is made into the possible existence of obstacles that may hinder a movement in the direction of system optimization. No independent test of the attainment of system optimization is presented. Similarly, a specification of the optimal transatlantic communication network based on all relevant objectives is not attempted. Rather, the interaction between selected structural and institutional features of the international telecommunications industry and the investment decision making behavior of AT&T and Comsat is analyzed. An examination of this interaction is undertaken with a view toward explaining its possible effects on the mix of plant, as well as the allocation and utilization of resources in the transatlantic communications network.

Approach and Major Conclusions

The market structure of an industry is an important explanatory variable of the conduct of firms which, in turn, affects performance. The institutional and structural features of the international telecommunications industry, as it exists in its present form, are examined first. The interrelationship of AT&T and Comsat is complex and unique and offers a possible explanation for the functioning of this industry in meeting communications requirements. The overriding implication of the market structure is that significant imperfections are present.

These imperfections are likely to hinder the ability of the firms to adapt to changes in a fashion that fosters a movement toward an optimum system.

Investment policies of firms influence the performance of an industry and are also important in their effect upon market structure. The policies of AT&T and Comsat toward additions to existing capacity, methods of depreciation, and retirement are analyzed. The fact that cable and satellite systems are very capital intensive and relatively inflexible, once installed, give the investment policies added significance. The service life of cable systems is long and that of satellites is increasing. As a result, decisions, particularly regarding cables, have long lasting effects on the provision of communication services. There is a strong indication that particular aspects of the investment policies are inappropriate in an environment characterized by rapid change. The investment behavior is primarily geared toward firm objectives. AT&T is attempting to maintain its dominant position through investment while Comsat is concerned with capturing a significant portion of the market by increasing the reliance on satellite communication. In consequence, the achievement of system optimization may suffer.

Empirical analysis, supplementing the descriptive analysis of investment policies and the structural-institutional features, follows. The empirical analysis takes the form of cross-sectional calculations of annual unit accounting costs and output-input indices for individual cables and satellites over the 1965-1970 time frame. These two measures are used in an attempt to compare unit accounting costs and productivity of individual facilities in operation over this time period. These measures are helpful in assessing the consequences of Comsat and AT&T investment decisions and operating procedures for facilities in use. Significant differences exist among individual cables and satellites in both annual unit accounting costs and productivity. The conclusion is drawn that the market environment does not produce sufficient incentives, and indeed appears to hinder tendencies toward system optimization.

The final chapter offers several suggestions to improve operation of the transatlantic network or at least to improve the ability of the Federal Communications Commission to regulate the firms engaged in supplying overseas communications services. This chapter consists of two main sections. One section considers the information needed to enhance the effectiveness of regulation. To the extent this additional information has no significant impact on the firms, more decisive action may be in order. Therefore, the second section offers some preliminary suggestions that would lead to a more fundamental restructuring of the industry.

CHAPTER II

ORGANIZATION AND MARKET STRUCTURE OF THE INTERNATIONAL TELECOMMUNICATIONS INDUSTRY

The market structure of an industry may be an important factor in explaining the behavior and performance of the firms composing an industry. The international telecommunications industry provides a striking example of the potential impact of market structure and how it may impede operation of the communication network.

The international communications industry is divided into two interrelated segments for purposes of discussion. At one level are the common carriers who supply communication services directly to the final user. The common carriers partially own the facilities used to provide these services. The other segment of the industry is represented by Comsat. This firm provides facilities but does not generally supply communication services to the final user. Rather, Comsat leases facilities to the common carriers, for the most part. However, Comsat is a unique and complex firm. The common carriers have an ownership interest in Comsat and one, AT&T, is represented on the Board of Directors. Comsat serves in three different capacities: as a common carriers' carrier, as a member of the International Telecommunications Satellite Consortium (Intelsat), and as the manager for Intelsat. As a member of Intelsat, Comsat is not in a position to act independently on all aspects of satellite communication without following the policies of Intelsat. In addition, Comsat is regulated by the Federal Communications Commission whose decisions also affect the firm's operations. The interrelation of the firms, Intelsat, and the FCC affects the transatlantic communication network in a manner that may not be entirely beneficial to the promotion of an optimal network. The interrelationship and its implications are developed in this chapter.

Growth of International Telecommunications

In recent years the international telecommunications industry has been experiencing rapid and continuous change. The dynamic nature of this industry is exemplified by the growth in communication traffic and technological innovation. Annual traffic has been expanding at an exceptionally rapid pace. Measured in terms of total minutes, transatlantic telephone traffic increased 88 percent over the 1965-1969 period, with the annual rate of change varying from a low of 6 percent to a high of 25 percent.[1] Growth of telex traffic exceeded that of telephone traffic. For the same period, measured in minutes, telex grew 185 percent with the annual rate varying from 27 percent to 32 percent.[2] Telegraph traffic, another principal form of communication in the transatlantic network, experienced little growth over this period. Measured by words, it increased only 3 percent with the annual rate varying from 4 percent to a negative 1 percent.[3] The stability of telegraph traffic was more than offset by the exceptional growth in telephone and telex traffic.

To a large extent, the increasing demand requirements for transatlantic service may be explained by advances in communication technology that have resulted in an expansion of cable capacity, improved quality of service, and a reduction in the per circuit investment cost. In fact, development of the first transatlantic, repeaterized cable, TAT-1, by the American Telephone and Telegraph Company (AT&T) and the General Post Office of England, provided the original impetus to this traffic

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[1] Federal Communications Commission, Statistics of Communications Common Carriers, 1965-1969 (Washington, D.C.: Government Printing Office), Table 15. The percentages are based on transatlantic traffic to and from Europe, Africa, and the Middle East. Some traffic to certain Far East countries, e.g., India, Pakistan, and Ceylon, also uses transatlantic facilities but it has been excluded from the totals.

[2] Ibid., Table 24.

[3] Ibid., Table 23.

growth. TAT-1 commenced operation in 1956 and was a major advance in cable technology. This cable had an original capacity of thirty-six equivalent voice-grade circuits enabling it to handle thirty-six telephone conversations simultaneously.[4] The instant success of TAT-1 stemmed from its high quality of service and reliability, and demand grew so rapidly (traffic volume nearly doubled in one year) that additional capacity was soon needed. To meet the traffic demand, TAT-2, a technological duplicate of TAT-1, was installed in 1959.[5] Techniques were developed to increase the capacity of TAT-1 to forty-eight voice circuits, and it was further expanded by 37 circuits with the introduction of Time Assignment Speech Interpolation (TASI) equipment in 1960.[6] More advanced cables with larger capacity have been developed to meet the continued growth in demand. A new lightweight cable design using rigid

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[4]A voice grade circuit serves as a unit that indicates the capacity of communication facilities. It is the unit or fraction which customers purchase and is the amount of frequency bandwidth required to transmit a normal telephone conversation. Telegraph messages, data sent at various transmission speeds, television and other possible uses all require either fractions or multiples of this basic capacity unit.

[5]TAT-2 is longer than TAT-1 and requires 57 flexible one-way repeaters compared to 51 for TAT-1, otherwise the cables are identical.

[6]TASI is a device which takes advantage of the pauses in speech and enables a cable to handle an increased number of telephone conversations with no increase in the circuit capacity of the original cable.

two-way repeaters was introduced with TAT-3 in 1963.[7] This cable, like the soon-to-follow TAT-4, had an original capacity of 128 circuits that was subsequently increased to 138 circuits. With the most recent cable, TAT-5, incorporating a transistorized repeater, capacity jumped to 720 circuits.[8] Service with the TAT-5 was initiated in March, 1970.

While the advances in cable technology were important, a very significant technological breakthrough after TAT-1 was the development of satellite communication. The development of satellites as a means of communication culminated in the launching of Intelsat I (Early Bird) on June 29, 1965, and introduced communication to the space age. The basic capacity of Intelsat I was 240 equivalent voice-grade circuits for point-to-point communication in the heavy traffic corridor between North America and Europe.[9] Intelsat I was quickly followed by Intelsat II in 1967, also with 240 circuits, but equipped with multiple station access capability and earth mode coverage (northern

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[7]The original cable, TAT-1, was actually a twin cable with each cable being unidirectional and therefore, the repeaters were one-way. TAT-3 was a single cable capable of transmitting in both directions with the two-way repeater.

[8]The original estimate of the capacity of TAT-5 was 720 circuits. This figure was then revised to 825 circuits after operation commenced. It now appears that 845 circuits can be obtained from TAT-5.

[9]Point-to-point communication refers to the fact that the satellite could operate between only two earth stations at one time.

and southern hemispheres).[10] Satellite capacity jumped to 1,200 voice-grade circuits with the inauguration of Intelsat III in 1968. This satellite series exapnded multipoint communications capability and the capability for transmitting all forms of communications simultaneously. In a relatively short period, international telecommunications experienced traffic growth approximating a compounded annual rate of 20 percent per year and two major technological innovations.

The advent of communication by satellite altered the conditions existing when submarine cables were the primary means of transoceanic service. Prior to satellites, each additional cable stimulated new demand to such an extent that, in short periods of time, capacity was insufficient. This situation was temporarily relieved by cables with greater capability. However, due to the limited number of circuits in the original TAT cables there was constant pressure to expand capacity. While satellite communication continued to stimulate demand and permitted new forms of transoceanic communication, e.g., television transmission, the quantum jumps in capacity initially produced by the emergence of the satellite raised the possibility of excess capacity for extended periods of time.

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[10]Multiple station access capability means that a satellite can operate with several earth stations at one time. Early Bird communicated with only two earth stations. The communication link was dedicated between a U.S. earth station and one in Europe. The down link in Europe rotated among the five European stations on a periodic basis.

Market Structure of the International Common Carriers

The assimilation of technological change and adaptation to expanding demand by an industry is influenced by the market structure and institutional features existing within the industry. Certain industry structures are likely to be more conducive to incorporating these factors than others. For example, in a perfectly competitive market a cost reducing innovation will be immediately introduced. If existing firms do not adopt the change, a new firm will enter the market and, because it can undersell its rivals, the remaining firms will be forced to follow suit or their survival will be jeopardized. Similarly, in the case of expanding demand, existing firms will increase their scales of production and new firms will be attracted to the industry thereby increasing supply. On the other hand, a monopolist is not confronted by similar pressures that force him to adopt a technological change. If the monopoly firm has developed the innovation and feels that other firms will not be able to duplicate the new process and impinge upon his market, pressures will be all the weaker. For similar reasons, growing demand may only be countered by an increase in price. Neither active nor potential market pressures may be present in a monopoly situation to produce results that are guaranteed in a perfectly competitive structure. The structural and institutional features of the international communications industry more closely approximate the monopoly situation and, therefore, require close scrutiny.

The market structure of the international communications industry is examined in two parts because of its unusual nature. One segment is composed of the four primary international common carriers: AT&T, International Telephone and Telegraph World Communications (ITTWC), RCA Global Communications (RCAC), and Western Union International (WUI). The second part of the market structure involves the two firms, AT&T and Comsat, that provide communication facilities. The four common carriers provide communication services directly to the final user, and are the American owners of the five TAT cables on an Indefeasible Right of User basis, or on an ownership basis.[11] Cable ownership is, therefore, a joint venture.[12]

Although ownership is cooperative, the common carriers do not serve the same market as a result of the TAT-4 decision.[13] This decision divided the market into two categories: (1) voice communication, and (2) record

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[11]An Indefeasible Right of User is a long-term, nonrevocable lease through which the user is assessed a prorata share of the costs of the cable.

[12]In addition to the joint ownership by American firms, each cable is partially owned by one or more foreign entities known as foreign correspondents. Ownership is generally on a 50/50 basis between the American firms and the foreign correspondents.

[13]American Telephone and Telegraph Company, 37 FCC 1151 (1964).

and alternate voice-record communication. AT&T is the sole supplier of voice service and the record carriers (ITTWC, RCAC, and WUI) serve the remaining portion of the market.

The rationale underlying this market division emphasizes an important characteristic of the industry. Originally, the transatlantic cables installed by AT&T and its foreign correspondents were for telephone use only. The telegraph (record) carriers operated their own facilities. However, the TAT cable circuits could easily handle telegraph traffic because it requires less capacity per unit than telephone traffic, i.e., one telephone circuit can be divided into numerous telegraph channels, (20-40), depending on the equipment used. AT&T made cable facilities available to the telegraph carriers on the same basis as it leased them to the general public. As a result, the telegraph carriers were at a distinct disadvantage in providing leased voice-grade circuits for leased voice-record use. The cost of a circuit in the telephone cable to the telegraph carriers was identical with the charge to potential customers, e.g., the U.S. Government, for leased circuits, thus preventing the carriers from competing with AT&T on an equal basis.[14] As noted by the Federal

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[14]AT&T's pricing practice, in this instance, is an excellent example of limit-entry pricing. In this case, pricing was used for the purpose of eliminating competition by the record carriers so that AT&T could extend its monopoly from voice communications into the alternate voice-record market.

Communications Commission in the TAT-4 decision, this set of circumstances would seriously jeopardize the viability of the record carriers if allowed to continue, because

> when we [the Commission] permitted AT&T and the record carriers to compete for the business of defense agencies for leased circuits for alternate and simultaneous voice-record use, AT&T received all the leases despite the fact that it was then authorized to provide circuits to the international record carriers for their use in competing with it for this business.[15]

The danger existed that AT&T, already a virtual monopolist in voice traffic, could take advantage of its position as owner of the cables, and extend its monopoly to the alternate voice-record market and possibly to the entire international field. International communications would then become an extension of its domestic monopoly. In order to curtail this threat, the FCC divided the market and prohibited AT&T from making further incursions into alternate voice-record traffic. The international record carriers were also granted a share of the ownership in cables on the basis of a formula prescribed by the Commission. The telegraph carriers are, thus, assured of the record, alternate voice-record market and compete among themselves in this growing area.

Although the communications market is divided, AT&T continues to be the sole common carrier engaged in

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[15]American Telephone and Telegraph Company, op. cit., p. 1159.

adding cable facilities across the Atlantic. AT&T has determined the need for the TAT cables, and upon receiving FCC approval, has installed them. However, the addition of facilities by AT&T is not a unilateral action. AT&T must negotiate with foreign parties in addition to obtaining a landing and laying license from the FCC for each cable terminating in the U.S. Each cable terminates in a foreign country. The foreign entities involved in communication ventures must, therefore, be accommodated. The agreement between AT&T and the foreign entities involves all aspects of a particular cable, from sharing the investment expenditure to circuit allocation to foreign points from the U.S. Thus, on the one hand, AT&T's ability to act independently is constrained by its agreements with foreign entities, and on the other hand, by the requirement for FCC approval of the cable application.

The role of the record carriers is of minor importance in initiating additions to existing facilities. As a group, they share a portion of the investment and operating costs and are allocated a minority share of the circuits as determined by the FCC on the basis of the number requested by all applicants in relation to the circuit capacity of the cable. They own about one circuit to every three owned by AT&T which is the predominant influence in applying for new cable authorizations.[16] Their main function in these formal requests for new cables appears to be the support of AT&T applications.

A primary source of AT&T's dominant position in international communications, vis-a-vis the record carriers, is the vertical integration of the firm. In addition to providing retail service, AT&T is involved in the development and manufacture of submarine cables. Bell Laboratories, which has been involved in the development of each TAT cable, performs the research and development function for AT&T. Western Electric, the manufacturing affiliate of AT&T, adds to the vertical relationship. Western Electric has produced an increasing portion of the components comprising a cable system since the installation of TAT-1.[17] Finally, there is ownership of the cable-laying ship, Long Lines, by AT&T. The Long Lines commenced service in 1963 with TAT-3, and has been used for laying subsequent cables. Thus, the AT&T network is virtually complete: from

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[16]In their replies in FCC Docket 18875, as of May 30, 1970, the record carriers indicated a total of 145 cable circuits in service while AT&T had 537.

[17]An analysis of cable investments shows that AT&T was initially involved in cable development and the manufacture of repeaters. With TAT-3 it expanded to cable loading and laying, and with TAT-4 Western Electric manufactured a portion of the cable. After the completion of the TAT-5 project, AT&T closed its cable manufacturing plant in Baltimore. However, AT&T continues to produce the cable repeaters, a significant portion of the total investment cost.

the design of segments of the cable systems to retail services for the consumer.

Although the exact effect of AT&T's vertical integration is difficult to determine, it does give AT&T the capability for maintaining its dominant position. The record carriers have not designed, produced, and installed a modern, high capacity transatlantic cable.[18] AT&T's involvement in the development of cables provides the company with an ability to control the rate of innovation, unchallenged by the record carriers. AT&T has been the sole American firm involved in designing the TAT cables, and by capitalizing on its entrenched position as a complete, vertically integrated firm, AT&T can safeguard its position with the record carriers dependent on it for cable circuits.[19]

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[18]Standard Telephones and Cables, Limited, a subsidiary of ITT, manufactures cables and repeaters. This English firm manufactured half of the TAT-3 cable before Western Electric began cable preduction with TAT-4.

[19]It is interesting to note a statement attributable to Harold M. Botkin, Assistant Vice President of AT&T and a member of the Board of Directors of the Communications Satellite Corporation at the time. The statement indicates that AT&T may favor a conservative, low-risk policy with regard to technological innovation:

> We feel, however, that the desired performance can be better achieved through extension and refinement of techniques that have proven integrity. Such an approach eliminates the hazard of depending on basically different techniques not yet proven in the rigors of a submarine cable environment. . . . Substantial manpower and costs are involved in the detailed development of the S.G. system. Before

While the relation between AT&T and the record carriers is important, the second aspect of market structure in this industry is more significant. This aspect involves the relationship between AT&T and Comsat and is the more relevant rivalry because the satellite system offers an alternative communication system that may counteract AT&T's dominance. The position of Comsat in the industry and its relation to the common carriers is quite complex and must be examined in detail to understand the ramifications of this market structure and its attendant implications.

Comsat and Its Relations to the International Carriers

Organization and Ownership of Comsat

Congress provided for the establishment of Comsat, the United States' representative to the International Telecommunications Satellite Consortium (Intelsat), with the enactment of the Communications Satellite Act of 1962.[20] As outlined by Congress, the objective was to "reconcile private ownership and profits with rapid development of a

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> starting this detailed development it is desirable that we have reasonable assurance that this system will be used.

This excerpt is from a letter to Bernard Strassburg, Chief of the Common Carrier Bureau, FCC, August 22, 1969.

[20] Communications Satellite Act of 1962, 47 U.S.C. (1962).

global relay and wide diffusion of benefits."[21] To accomplish this goal, a unique and heretofore, unprecedented organization was created.

Comsat, the sole U.S. firm in the field of international satellite communications, can justifiably be termed an experiment in industrial organization. This company is a privately-owned corporation that is subject to regulation by the Federal Communications Commission (FCC) and not an agency or establishment of the United States government. Ownership of Comsat is vested with communication common carriers, equipment suppliers, the general public, and limited foreign interests. The common stock is divided into two categories: Series I (public shareholders) and Series II (carrier shareholders). Series II stock is separated further into sotck with voting rights and non-voting stock. Those communication common carriers designated as "authorized carriers" are entitled to own stock with voting rights. The aggregate of the voting stock owned by common carriers, directly or indirectly, cannot exceed 50 percent of the shares of such stock issued and outstanding.[22] At the end of January, 1971, 93 communications common carriers held

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[21] Harvey J. Levin, "Organization and Control of Communications Satellites," University of Pennsylvania Law Review, CXIII, No. 3, 316.

[22] Communications Satellite Act, *op. cit.*, Section 304.

2,963,225 shares of Series II voting stock.[23] The leading stockholder was AT&T with 2,895,750 shares or 97.7 percent of Series II stock and about 30 percent of all voting stock. In addition to voting stock, Comsat is authorized to issue non-voting securities, bonds, debentures, and other certificates of indebtedness. To the extent that the common carriers own these non-voting issues, they may include them in their respective rate bases.[24]

In addition to owning Comsat stock that gives the common carriers voting power, the international carriers are represented on the Board of Directors. The Board of Directors is presently composed of nine members selected by the general public stockholders, three from the common carriers, and three appointed by the President of the United States.[25] The three common carrier Board members are representatives of AT&T. Common carrier stock ownership and representation on the Board have far-reaching implications that are compounded by other factors peculiar to Comsat.

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[23] Communications Satellite Corporation, Annual Report 1970, 1971.

[24] Communications Satellite Act, op. cit., Section 304. To date this type of stock has never been issued.

[25] Originally the Board was composed of six common carrier representatives, six public representatives, and three Presidential appointees, as stipulated in the Communications Satellite Act. Board representation was altered to the present configuration in 1971.

Representation of the international common carriers on Comsat's Board of Directors presents the immediate problem of conflicting interests.[26] These representatives must promote the Congressional mandate of rapid technological development in satellite communications. At the same time, as submarine cable owners, they cannot remain impartial to the interests of the international common carriers whom they represent. The carriers have substantial investments in cable communication and are prohibited from investing in their own satellite systems. The extent of the cable interests is particularly true of record carriers whose rate bases depend on cable and radio investment, with the exception of minor earth station interests.[27] Since the allowable return for a regulated firm is directly proportional to its rate base, assuming the same rate of return, the carriers have a strong incentive to protect

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[26]The possibility of conflicting interests has not gone unnoticed. Senator Mike Gravel introduced a bill, S702, on February 10, 1971 that would bar carrier representatives from sitting on the Comsat Board after January 1, 1972 and bar carrier stock ownership after January 1, 1973. Representative Robert O. Tiernan introduced a bill, HR6651, that would give the common carriers until January 1, 1974 to sell their Comsat stock. Further, this bill would remove carrier elected members and Presidentially appointed members from Comsat's Board.

[27]The extent of record carrier interest in earth stations, as a percentage of total capital is as follows:

	1967	1968	1969
WUI	3.6%	5.3%	6.2%
RCAC	2.5	3.8	3.7
ITTWC	2.8	4.1	4.2

their investments. Achievement of this goal can be realized by depreciating facilities over their expected lives and not being faced with sudden obsolescence. However, rapid technological advance in satellites may jeopardize existing investments in cable facilities by rendering them obsolete, thereby subjecting them to possible removal from the rate base. Such an occurrence would leave the common carriers with a depreciating and declining portion of the industry's communications plant.

Under such circumstances it seems likely that the carriers would try to protect themselves against

> . . . the threat that satellites present to their existing and planned rate base which consists of cable and radio facilities, and a threat which virtually affects the "expeditious development" of the satellite venture and the future of the communications industry.[28]

Representation on the Board of Directors may enable the common carriers to protect their vested interests by placing them in a position to influence not only Comsat officials but other Board members not affiliated with cables. Such a consolidation may then be influential in affecting Comsat's plans and decisions regarding the satellite system. Thus, the carrier representatives have two fiduciary interests. The representatives are placed in a position of being required to promote the interests of satellite

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[28] Herman Schwartz, "Comsat, the Carriers, and the Earth Stations: Some Problems with 'Melding Variegated Interests,'" The Yale Law Journal, LXXVI, No. 3, 450.

communication while protecting the common carriers' interests. Obviously, the two interests will not coincide on all matters. A potential for conflict is clearly present and may result in a compromise in order to protect vested interests in cables. Satellite development then suffers.

Implications of Stockownership and Manufacturing Affiliations

Further complications may result from the distribution of stock. At least two record carriers are affiliated with firms capable of producing satellite system components. RCA, the parent company of RCAC, has the capability to produce satellite components. In addition, Sylvania Electric Products Inc., a subsidiary of GT&E which, in turn, gained control of the Hawaiian Telephone Company in 1967, was awarded a subcontract by Thompson, Ramo, Woolridge (TRW) for building the antenna system of the $40 million Intelsat III series.[29] ITT, the parent company of ITTWC, manufactured the transponders for the same satellite series.[30] At the time of the subcontracts, the President of the Hawaiian Telephone Company was a member of Comsat's Board

[29] Wayne E. Green, "Comsat's Failures Created Some Hardships, But Technology was Improved as a Result," *The Wall Street Journal*, July 17, 1969, p. 28. The figure of $40 million is $8 million greater than the basic price for six satellites as reported in Comsat's Annual Report of 1966.

[30] *Ibid*.

and ITT owned 1,050,000 shares of Comsat stock and was a member of the Board.

In addition to the integrated carriers, equipment manufacturers supplying satellite system components are entitled to ownership of Comsat voting stock. Ownership of voting stock raises the potential for favoritism in supplying the substantial requirements of Comsat. The problem posed by such ownership concerns the independent hardware suppliers who do not own Comsat stock. The fact that the independent firms are not stockholders may place them in an unfavorable position for any given contract vis-a-vis their competitors. The integrated carriers and equipment stockholders may have the desirable advantage of preference for the prime contracts to expensive satellite subsystems.

The possibility of favoritism in the awarding of contracts was recognized in the enabling legislation by requiring Comsat to buy equipment on a competitive bid basis. However, the procurement rules do not necessarily guarantee equal accessibility to contracts. The suppliers owning stock may still be in an advantageous position. These firms may have received some of the first contracts or subcontracts and, thus, gained invaluable experience and knowledge in the early stages of development. Such an advantage would undoubtedly give these firms a headstart that may be difficult for the independent firms to overcome.

This same result may occur if specifications for equipment are geared to facilities produced by particular hardware companies. If not specifically prevented, Comsat may indulge in favoritism by specifying model designs to favor the capabilities of particular equipment suppliers. The possibility of such an occurrence may have taken place with the Intelsat III generation of satellites. Hughes Aircraft Company, the spacecraft contractor for the first two generation satellites, lost the bid to TRW for Intelsat III. One reason given by Comsat officials was that Hughes was "unresponsive to Intelsat specifications."[31]

The implications of preferential treatment or inside knowledge are more serious if they result from representation on the Comsat Board of Directors. In this case, prior knowledge of Comsat's long-range plans may be combined with vertical integration of the common carriers. The integrated common carrier could have the advantage of additional time to design a subsystem meeting the rigid specifications of Comsat. Furthermore, the carrier would have the capability for manufacturing the equipment once it is designed. This knowledge would give an integrated carrier a decisive advantage in winning future contracts that may amount to many millions of dollars for one generation of satellites.

[31] Lawrence Lessing, "Cinderella in the Sky," Fortune, October, 1967, p. 201.

Ownership participation of this kind by some hardware manufacturers may also impede the research efforts by independent suppliers. An independent firm will be reluctant to engage in research without a reasonable chance of recovering research dollars. As a result, vertical integration combined with ownership participation may not be conducive to the independent supplier challenging the technical status quo, and may discourage innovative efforts in the equipment market. The dampening effect on research efforts may retard the development of satellite systems thereby neutralizing the potential benefits of satellites.[32]

A prime example of the difficulty facing a non-integrated, non-stockholding firm is illustrated by Hughes Aircraft Company, an aerospace equipment supplier. Before any satellites had been launched, AT&T proposed a global satellite network consisting of satellites, similar to its own Telstar, in random orbits at an altitude of 6,000 miles. This system involved approximately fifty satellites and highly sophisticated earth stations to track a satellite passing in and out of range every twenty minutes. If a pair of earth stations was to provide continuous transmission of communications, it would necessitate "picking up"

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[32]In this same context, it should be pointed out that the development of cable technology may be subject to similar impediments. In fact, the potential for even greater foreclosure to independent suppliers is present because of AT&T's vertical integration.

a new satellite as another moved out of range. The proposal involved a sizable capital outlay and was the basis for the original capitalization of some $200 million by Comsat.

In contrast with the AT&T plan, the synchronous satellite plan offered by Hughes Aircraft involved satellites being placed in orbit at 22,300 miles in a plane with the equator. In this orbit, the speed of the satellite is exactly the same as the rotation of the earth. Thus, the satellite appears to be fixed. Three satellites placed in such an orbit provide total earth coverage. Therefore, fewer satellites are needed than under the AT&T plan. Furthermore, since the satellites are essentially fixed, less complex earth stations are necessary. The simplicity of this plan relative to AT&T's proposal is reflected in significant cost reductions.

The synchronous satellite plan resulted solely from the research of Hughes and culminated with the development of Syncom, the original synchronous satellite. However, AT&T and others strongly favored the random orbiting satellites with extensive and costly ground systems. Hughes encountered considerable difficulty in gaining acceptance of Syncom which was technologically superior and provided a lower cost satellite system.

> For two years Hughes knocked on every door at NASA, the Defense Department, and AT&T, trying to sell the system. It was brushed aside as

> being technically unsuitable for telephone transmissions, and too simple to solve the tough problems of holding a satellite in synchronous orbit, a technology said to be at least ten years away.[33]

Comsat did enter into a contract with Hughes for synchronous satellites soon after the formation of its Board of Directors thereby defeating the AT&T satellite plan. The Board was originally formed in 1963 and the contract was concluded with Hughes in March, 1964 with the synchronous satellite becoming the standard approach to all satellite systems. This episode stresses the possibility of roadblocks to acceptance of a more advanced technology because of vested interests and the difficulty of an "outsider" in gaining access to the market.

Comsat's Function in the International Telecommunications Satellite Consortium (Intelsat)

Intelsat is composed of eighty member countries that finance and own the space segment of the satellite system. Within Intelsat is the governing body, the Interim Communications Satellite Committee (ICSC), established by the Interim Agreement.[34] Any entity or group of entities with a quota of 1.50 percent or more of financial investment is entitled to representation on the ICSC.

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[33]Lessing, op. cit., p. 202.

[34]A definitive agreement is being negotiated to replace the Interim Agreement and could result in some changes within Intelsat.

Presently there are eighteen members. Voting power in the ICSC is in proportion to the ownership interest of the participants.

The authority of the ICSC covers all aspects of the space segment of the satellite system.

> The ICSC makes all important policy decisions for Intelsat, including the pricing of units of satellite utilization, decisions relating to the award of important manufacturing and service contracts, satellite launchings and other matters necessary for the design, development, establishment, maintenance and operation of the space segment of the global communications satellite system.[35]

Decisions on most important matters coming before the ICSC require the vote of Comsat plus votes representing at least a 12 1/2 percent ownership interest. Thus, no decision can be made without Comsat concurrence, but Comsat approval will not guarantee passage of a policy without support from at least two other entities.

In addition to being the principal financial contributor to Intelsat and a representative on the ICSC, Comsat acts as Manager for Intelsat. In this capacity, Comsat procures the satellites and other facilities and equipment for the space segment, arranges for the launching of the satellites, operates the space segment, including the satellites and associated tracking, telemetry and command equipment, and collects and disburses all funds received from capital contributions and operating revenues.

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[35] Communications Satellite Corporation, Report to the President and Congress, 1968.

However, in spite of its duties as Manager of the space segment, Comsat cannot operate unilaterally. It must act pursuant to the general policies and specific determinations of the ICSC. Comsat is constrained in its actions by the necessity of securing approval from the ICSC. If, for example, Comsat determines that another satellite is needed in the Atlantic Basin, approval of the ICSC is needed before the launch takes place. This relationship serves as another constraint on Comsat's ability to act as a free agent, particularly in regard to investment decisions.

FCC Decisions Affecting Industry Structure and Conduct[36]

The joint ownership arrangement of Comsat with its attendant implications extends to earth station ownership. The Comsat Act empowers the FCC to

> grant appropriate authorizations for the construction and operation of each [U.S.] satellite terminal station, either to the corporation or to one or more authorized carriers or to the corporation and one or more such carriers, jointly, as will best serve the public interest, convenience and necessity. In determining the public interest, convenience, and necessity, the Commission shall authorize the construction and operation of such stations by

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[36]A more detailed discussion of these decisions is contained in "International Telecommunications: Dynamics of Regulation of a Rapidly Expanding Service" by Asher H. Ende in Law and Contemporary Problems, XXXIV, No. 2 (Spring, 1969).

> communication common carriers or the corporation, without preference to either.[37]

Originally there was a question about ownership and the point of interface. Comsat felt that it should own and operate U.S. earth stations while the carriers argued that they should be entitled to partial ownership rights. The question of interface involved a determination of whether it should be at the gateway city nearest the earth station or at the earth station sites. The Commission favored Comsat ownership and operation with interface at the earth stations in its First Report.[38] The terrestrial carriers would be permitted to provide the facilities between the gateway cities and the earth stations. However, ownership authorizations were amended by the Second Report in the "Earth Station" decision.[39] With this decision the FCC determined that U.S. earth stations would be jointly owned by Comsat and the international common carriers for an interim period with the former acting as station manager. For example, in the continental United States, Comsat would have a 50 percent ownership interest and the common carrier portion would be divided as follows: AT&T--28.5 percent;

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[37] Communications Satellite Act, op. cit., Section 201 (c) (7).

[38] Proposed Global Commercial Communications Satellite System, 38 FCC, 1104 (1965).

[39] Ownership and Operation of Earth Stations, 5 FCC 2d 812 (1966).

ITTWC--7.0 percent; RCAC--10.5 percent; and WUI--4.0 percent.[40] Shared ownership of earth stations redistributes a portion of satellite investment from Comsat to the common carriers for inclusion in their respective rate bases. However, there is another consequence of the Earth Station decision that could compromise use and development of satellite technology.

The rationale for the interim FCC ruling was that the carriers possessed technical knowledge that could be exchanged among concerned parties. The interchange of ideas and cooperation among interested parties was thought to be the most effective way to stimulate the advancement of earth station technology. Furthermore, participation in ownership would provide the carriers with an incentive for rapid development of a satellite system. Since the carriers had an ownership interest in the satellite system their concern for its success would be fostered. Also, direct ownership was thought to be the best assurance that the carriers would not unduly favor their cable systems at the expense of the satellite system. The earth station investments of the carriers would be included separately in their respective rate bases allowing the carriers to profit from the use of the satellite system. Thus, unprejudiced utilization of the two alternatives would be promoted by this decision. The Commission concluded that:

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[40] *Ibid.*, p. 819.

> reasonable and equitable opportunities would thereby be offered all entities which make use of the satellite facilities to make whatever contributions they can to the advance of the art and to the achievement of the objectives of the Satellite Act. No one carrier or group of carriers would be precluded from gaining valuable experience in this field. Ownership participation, and, investment would provide powerful incentives to maximize use. Orderly planning of needed new cables, satellite, and other facilities would be facilitated so that the inherent advantages of each could be exploited to the maximum.[41]

As against the above outlined potential benefits from joint ownership, one must consider the adverse effects that could flow from the possibility that the carriers' 50 percent interest gives them a "negative control," the ability to block action. Although Comsat acts as manager of the earth stations, the stations are subject to overall control and guidance on basic policy and investment matters by a committee composed of the particular carriers involved in the ownership. Voting in the committee is in accordance with actual investment, i.e., the ratio of the individual member's investment in earth stations to the total investment of all members in all stations. These committees have plenary authority because they are responsible for "formulating overall policy and deciding on major investments, types of major equipment and location of new stations, and the establishment of day-to-day operations of the stations."[42]

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[41] Ibid., p. 816.

[42] Ibid., p. 819.

Authority of this kind, residing with the carriers, has the potential for detrimental effects especially when there is such an apparent possibility for conflicting interests. It appears that the exercise of this authority could give the common carriers an influential hand in determining the introduction of new techniques to earth station technology. This, in turn, could affect utilization of the satellite system because satellite capacity, and hence satellite rates, depend directly on the size and efficiency of earth stations.

In addition to the ownership interests of the carriers in Comsat, the Satellite Act prescribes the relation of Comsat to the international common carriers regarding markets served. The enabling legislation designated Comsat as a common carriers' carrier. Originally, there was some question about the interpretation of this concept of a carriers' carrier but the dilemma was settled with the "Authorized User" decision.[43] Comsat would be entitled to carry only that traffic supplied by the common carriers. Offering any retail communication services, even to the Government, was prohibited except under "unique or exceptional circumstances" as determined by the FCC.[44] Thus,

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[43]Authorized Entities and Users--Comsat, 4 FCC 2d 421 (1966).

[44]It should be noted that the Authorized User decision does not completely ban Comsat from direct service to the ultimate user. There is the exception that if the

Comsat is relegated to the function of leasing circuits to the common carriers. With the exception of a small number of circuits leased to NASA, this is Comsat's sole form of business.

The rationale of the Commission in deciding to limit Comsat to the primary role of a carriers' carrier was based on two main considerations. Comsat was created as a monopoly firm in the provision of international satellite facilities. The existing common carriers could not launch their own satellites and, therefore, would have to lease satellite circuits from Comsat. Second, Comsat was interested in the private line service rather than the whole range of international communications services. The rapidly growing private line business was an important part of the revenues earned by the terrestrial record carriers. With a monopoly in satellite facilities Comsat would be in a position to charge the record carriers the same lease rate as it charged the final user. The record carriers would then lose their customers to Comsat. In addition, the carriers owned facilities of various ages while Comsat would operate with the newest facilities. If Comsat was not precluded from the private line market the

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user specifically requests satellite facilities and they are available, Comsat can provide direct service if the common carriers fail or refuse to fulfill the request. Furthermore, Comsat is permitted to promote satellite communication and solicit customers.

record carriers would be unable to compete with Comsat's modern facilities and they would be unable to average their costs in the establishment of rates. The customers of other services, message telephone, message telegraph, and telex, would then be faced with higher charges. In consequence, Comsat was restricted but the carriers were required to reflect any economies in the use of satellite usage in their rates.

Committing Comsat to the role of a lessor curtails its ability to effectively compete with the carriers. The satellite company is placed in the unenviable position of being dependent on those firms for its business which, at the same time, compete with Comsat for business. Furthermore, the Authorized User decision appears to place the common carriers in a strategic position for determining the use and need for satellite and cable facilities. Most communication services can be provided by either satellite or cable, the primary exception being television transmission. Since the carriers, alone, service the final market they are in the unique position of determining the circuits needed to each point to meet actual requirements. Additionally, once cable and satellite circuits have been activated between countries the carriers are in a position to determine the distribution of all common traffic between the two systems. For example, AT&T determines the division of telephone traffic between cables and satellite circuits that are in service. But the carriers, while leasing satellite circuits, have substantial investments of their own in submarine cables. Due to their vested interests in cables, the common carriers would be expected to favor utilization of the facilities they own because these investments are much larger than their interests in the satellite system. Having control over the utilization of both communication systems in this way assures the carriers of continued use of the cable system. In addition, favoring cable circuits will result in more rapid pressure on capacity. Full utilization of cables will enable the carriers to propose additions to the existing cable facilities, thus increasing their rate bases and expanding their earning potential.

The Authorized User decision increases the ability of common carriers to protect their investments by diverting traffic to their own facilities. The possibility for such a diversion of traffic did not go unnoticed by the carriers. In fact, the carriers looked upon diversion as a necessity under certain circumstances. As pointed out by an ITT spokesman, without some control over the competing satellite technology, which presented a possible serious threat to their investments,

> it would then be the duty of the common carriers to their stockholders to avoid such dilution, insofar as possible, which would undoubtedly tend

> to reduce their use of the satellite systems in favor of the existing systems which the carriers own.[45]

The possibility of the carriers avoiding satellite usage in favor of cables was also recognized by the FCC in a 1966 decision.[46] The simultaneous installation of cable and satellite facilities required some agreement on circuit activation to insure usage of the satellite system. The Commission ruled, in effect, that in this particular situation requirements for new circuits would be satisfied on an equal basis, i.e., a 50/50 activation of circuits between the new cable and new satellite facilities.

This method of determining circuit utilization was altered in the TAT-5 decision.[47] This decision produced the proportionate fill policy to be followed with the installation of the TAT-5 cable. To insure use of the satellite facilities after the TAT-5 became operational the

> unfilled capacity of the satellites would be leased at a rate, with appropriate adjustments, so that, when added to the use made of the satellite facilities by non-cable users, unused satellite capacity would be leased by all users as the cable is filled to the end that both types of facilities reach 100 percent fill at approximately the same time.[48]

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[45]Henri Busignies, Hearings before the Committee on Aeronautical and Space Sciences, 1962, p. 294.

[46]ITT Cable and Radio, Inc.--Puerto Rico, _et al_., 5 FCC, 2d 823 (1966).

[47]American Telephone and Telegraph Company, 13 FCC 2d 235 (1968).

[48]_Ibid_., pp. 237-238.

The proportionate fill policy continued in effect although the ratio of satellite to cable circuit activation was recently changed to 5 to 1 after the introduction of the Intelsat IV generation. The 5 to 1 ratio has been subsequently revised to a 1 to 1 ratio, on a country-to-country basis, for the remaining unused TAT-5 circuits activated by AT&T.

Role of the FCC and Other Government Agencies

The Federal Communications Commission, as overseer to international communications, is empowered with a number of provisions in accomplishing its task. It is charged with achieving the fundamental goal of "an efficient, economical, nationwide and worldwide communications network to meet the needs for service and to support the national defense."[49] The authority and power to accomplish this broad goal is provided by the Communications Act of 1934,[50] as amended, and the Communications Satellite Act of 1962. The former act is applicable to submarine cable services and, except when inconsistent with the Satellite Act, applies also to satellite services.

In addition to the general objective of the FCC, specific provisions in both acts enumerate the nature and

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[49] Asher H. Ende, Hearings before a Subcommittee of the Committee on Government Operations, July 24 and 25, 1967, p. 92.

[50] Communications Act of 1934, as amended, 47 U.S.C. (1964).

extent of the Commission's jurisdiction over cables and satellites, services, charges, practices, regulations, records, and acts of communications common carriers. The stipulations of the Communications Act, as they apply to international communication, include the following. Every common carrier must furnish communication service upon reasonable request. The Commission has the authority to order physical connections with other carriers, establish through routes and charges, and provide for facilities for the operation of through routes. Charges, practices, classifications, regulation, facilities, and services must be just and reasonable, otherwise they will be declared unlawful. Prohibition of unreasonable discriminations and preferences fall within the authority of the FCC. The carriers are required to file schedules of their charges which cannot be changed without giving due notice to the Commission. The Commission has the authority to suspend these schedules and, after hearings, establish just and reasonable charges that must be followed. The Commission is given authority over the valuation of property and must keep informed on new construction, extensions, improvements, retirements, and other changes in the condition of common carrier property. The FCC can require annual and other reports and prescribe depreciation charges. The Commission has the authority to examine the transactions of the carriers regarding equipment, supplies, research, and other services affecting the charges made, or the services rendered, to the public.

The Submarine Cable Act of 1921,[51] as implemented by Executive Order Number 10530,[52] provides the FCC with the authority (upon receiving concurrence of the State Department) to issue, withhold, or revoke licenses to parties desiring to

> land or operate in the United States any submarine cable directly or indirectly connecting the United States with any foreign country, or connecting one portion of the United States with any other portion thereof. . . .[53]

This Act is supplemented by the Communications Act which stipulates that a carrier must obtain a certificate from the Commission by demonstrating that the public interest, convenience, and necessity require construction and operation of an additional or extended line, or discontinuance of some service.

The Communications Act is supplemented by the Satellite Act giving additional powers and responsibilities to the FCC regarding satellite communication. The additional powers include the following stipulations. The Commission must insure effective competition, including competitive bidding. Authorized users shall have nondiscriminatory use and equitable access to the satellite system. The facilities of the system must be technically

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[51]Submarine Cable Act of 1921, 47 U.S.C. (1921).

[52]Executive Order Number 10530, May 11, 1954.

[53]Submarine Cable Act, _op. cit._, p. 8.

compatible and interconnected operationally with each other and with existing facilities. Economies made possible by the satellite system should be appropriately reflected in rates. No substantial additions shall be made to the facilities of the satellite system unless required by the public interest, convenience, and necessity.

In short, the Communications Act and the Satellite Act give the FCC broad and specific provisions for the regulation of international telecommunications. The responsibility of coordinating and evaluating the various viewpoints and objectives rests with the Commission. Except for the cable landing license, on which State Department concurrence is necessary, the Commission is the action agency in international communications matters involving U.S. carriers. This agency has the final authority and responsibility for making the decisions concerning the international carriers.

In addition to the role of the FCC in international telecommunications, other agencies of the United States Government have responsibilities in this area. The international aspect requires dealings and negotiations with foreign entities. The State Department, therefore, is involved. This Department acts in the capacity of an advisor to the Commission on foreign relations considerations. For instance, the State Department advises the

Commission on the foreign relations aspects to be considered in reaching a decision on a new cable application.

The Department of Defense has an interest in communications facilities. This Department serves two roles. One role is an advisor to the Commission on national security aspects of proposed facilities and their operation. In its second capacity the Defense Department, through the Defense Communications Agency, contracts with the common carriers for circuit utilization to meet the national defense requirements. As a user of communications facilities DCA can make presentations before the Commission on matters such as facility applications and rate hearings.

The Office of Telecommunications Policy (OTP) has the task of managing the Government's use of its frequency allocations and providing advice to the President concerning national telecommunications management and policy problems. OTP, along with the FCC, provides assistance and advice to the State Department relating to international telecommunications policies, positions, and negotiations.

The difficulty presented by this myriad of agencies participating in international telecommunications is the possibility of serious administrative-regulatory problems resulting from overlapping jurisdictions. This complication is all the more probable if the different agencies view the objective of international communications differently. The Defense Department would view the system primarily as a potential military resource. The State Department would envisage it as a means to hasten the growth of underdeveloped countries and as a safeguard against war. If the objectives of the various agencies are not sufficiently coordinated, the provision of cable and satellite facilities for communication requirements may be seriously distorted.

Summary

The international communications industry is in a state of constant change. Demand is expanding at a rapid annual rate and technological improvements are frequent. Although the market structure attempting to rationalize these conditions is ostensibly oligopolistic, it is more realistically described as a duopoly, with modification, because only two of the firms provide communication facilities. AT&T is the dominant firm. Comsat, the other duopolist, is restricted in its latitude. Comsat is essentially a joint venture, being partially owned by common carriers and subject to carrier representation on its Board of Directors. The ability of Comsat to compete with the common carriers is impeded by the Authorized User decision designating Comsat as a common carriers' carrier. Thus, Comsat is essentially a vertical affiliate of the international carriers. Furthermore, these carriers have substantial vested interests in the alternate communication mode, submarine cables. The international carriers are simultaneously potential suppliers, customers, competitors, and owners of Comsat, aptly characterized as a "meld of variegated interests."

In addition to the probably diversity of interests and objectives of the firms, various government agencies, with different policy objectives, participate in international communication. The presence of these agencies is likely to increase the difficulty of satisfying all goals concurrently. Furthermore, the implications drawn from the interrelations of the common carriers and Comsat substantiate the suspicion that the goals may not be realized. It is not sufficient to conclude, as one writer has, that "in view of the proven performance of the industry[54] . . . the public is being served by rapidly developing technologies which are providing vastly increased communications capability at declining rates."[55] A more realistic implication is that the current structure and organization of this industry may be stifling potential forces tending to encourage progress in the direction of an optimal network. Further examination, into the investment behavior of AT&T and Comsat, may be fruitful.

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[54]George E. Ashley, "International Communications: What Shape to Come?" Law and Contemporary Problems, XXXIV, No. 2 (Spring, 1969), 417.

[55]Ibid., p. 428.

CHAPTER III

INVESTMENT POLICIES OF AT&T AND COMSAT AND REGULATORY POLICY

The market structure of the international communications industry exhibits a number of characteristics that may not be conducive to optimizing behavior. The ownership of facilities may be a further inhibiting factor by inducing sub-optimal investment behavior. No single firm is in a position to choose between cables and satellites in making an investment decision, unfettered by vested interests. Indeed, preferences resulting from ownership may be controlling. AT&T, aside from minor earth station interests, can invest only in submarine cables. Conversely, Comsat is restricted to satellite facilities. Because of the restriction on investment, market strategy assumed added importance in the promotion of firm goals since they must be achieved through ownership of one technology. The investment policies play a major role in the firms' strategies. Comsat and AT&T can use investment as a vehicle to establish or to reinforce markets, to insure continued use of a technology, to achieve an integrated communication network, or a number of other goals. If system optimization is to be promoted, the investment efforts of both firms must be sensitive to the timing of additional facilities, the cost of alternatives, and the timing of depreciation allowances.

In a competitive environment, market pressures provide the incentives for investment behavior. A firm making suboptimal investment decisions would be penalized by a loss of business and possibly bankruptcy. The type of capital used by AT&T and Comsat and the market structure (Comsat is a Congressionally created monopoly) apparently preclude the possibility of relying on effective competition. The discretion of the two firms must be relied on to produce an integrated network resulting from a planned construction program that introduces facilities at the right time. However, the probability of preference and the inherent tendencies stemming from rate of return regulation may result in behavior that is contrary to promoting system optimization.

The importance of investment policies and the a priori implications indicate the need for further examination. Therefore, the investment policies of AT&T and Comsat are examined in terms of overall objectives, the factors entering decisions on individual projects, and depreciation policies. The potential impact of these factors on promoting system optimization is then discussed. Since the FCC has final authority in the approval of investments by Comsat and AT&T, the criterion used to evaluate investment proposals and selected policy decisions of the Commission are examined. Because of the rapid pace of technological change, a section is devoted to the implications of the depreciation policies of AT&T and Comsat as they affect the integrated communication network. The interaction of market structure, investment behavior, and regulatory policies concludes the chapter.

Significance of Investment in International Communications

The nature of the capital used in international communications is much like that of other public utilities. Both mediums of communications, cable and satellite, are highly capital intensive. The capital is characterized by significant indivisibilities and decreasing unit costs as the initial cost is spread over more and more circuits with increased utilization of the line haul portions of the systems. The most recent cable, TAT-5, has a basic capacity of 845 voice grade circuits while the new generation of satellites, Intelsat IV, has an estimated capacity on the order of 5,000 circuits. The existence of significant indivisibilities indicates that intensive utilization of the facilities will tend to minimize unit costs.

The characteristic of durability is also associated with the capital of regulated firms. The submarine cable fits this pattern. The cable has a service life of 24 years. Satellites, on the other hand, are in operation for a relatively short time. The current satellite, Intelsat IV, has an anticipated life of seven years, a two year increase over its predecessor. This difference in facility lives allows technological advances to be incorporated at a more rapid pace through satellites than cables. New satellites replace existing ones while a new cable supplements existing capacity.

Given the nature of the capital and the expanding demand for communication services, the timing of investments in cables and satellites assumes added significance. Additions to capacity must be timed in a manner that avoids excess capacity for extended periods of time and permits a consistently high level of utilization of existing facilities in order to realize potential economies. If investments are not synchronized with existing capacity and expected demand, load factors may be reduced as traffic is diverted to new facilities. To illustrate, in the TAT-5 controversy Comsat argued that another cable was unnecessary to meet expected requirements. The impact of the TAT-5 was said to be a burden on users because it would merely divert traffic away from satellites. In short, TAT-5 was an unneeded facility according to Comsat. The threat of excess capacity resulting from improper timing or overinvestment must be guarded against because of the deleterious impact on realizing scale economies through intensive utilization.

The concern with excess capacity is enhanced by the tendency that may exist with rate of return regulation. A regulated firm cannot simply maximize the net discounted present value of an investment as the unregulated firm would do. A constraint is placed on the maximum allowable return in each year. The inherent logic of this constraint is that, when the fair rate of return exceeds the cost of capital but is less than the unregulated monopoly, there is a tendency to overexpand capital and, thus, increase the absolute level of profits. Investment behavior may be distorted. As a result, excess capacity develops and facilities are not efficiently utilized because potential economies are not realized.

Aggravating the potential for overinvestment is the inherent preference of each firm for one type of capital. Neither firm is in a position to choose between satellites and cables when evaluating investment alternatives. Comsat is restricted to satellite investment and AT&T provides cable facilities. A priori, Comsat will advocate additional satellites when increases in capacity are necessary and, thereby, expand its profit potential. On the other hand, AT&T is precluded from launching satellites but may lease circuits from Comsat to meet demand requirements. However, leased circuits add to expenses without affecting AT&T's rate base. Only additional cables will expand AT&T's rate base (with the exception of its percentage ownership of earth stations) and, therefore, its profit potential. In consequence, AT&T would presumably favor expansion by submarine cables. As noted by the President's Task Force on Communications Policy there may be other reasons to prefer owning as opposed to leasing circuits. Additional considerations include a business policy of providing customers with complete service under their control, reluctance to become dependent on Comsat, actual or imputed differences between cable costs and lease costs, and concern over being relegated to a minor role.[1]

The potential for behavior arising from this ownership arrangement that is beneficial to AT&T but contrary to system optimization can be illustrated. AT&T is in a position to lease circuits from Comsat as the need arises. If the cost of leasing is less than the cost of owning cable circuits, absolute profits of AT&T will be increased by leasing circuits for overseas transmission. There is a tendency toward monopoly profits that are readily discernible and not camouflaged by the parallel increase in rate base. However, the existence of a regulatory lag between the realization of profits and FCC reaction in the form of rate reductions may provide sufficient incentive for this type of behavior (particularly since profits from AT&T's international operations are not segregated from

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[1]Final Report--President's Task Force on Communications Policy, December 7, 1968, p. 11.

its total operations in determining the rate of return). If rate reductions are to be avoided, the excessive earnings must be concealed. As a short run measure additional, non-compensatory satellite circuits could be leased. (The behavior discussed could provide a rationale for AT&T's offer that it and ITTWC would lease 100 voice grade circuits from Comsat in the Caribbean as soon as satellite facilities became available. As part of this offer an application for a new 720 circuit cable to the same area was filed with the Commission.)[2]

Leasing non-compensatory circuits in order to camouflage excessive earnings would appear to be a self-cancelling measure if viewed only in the short run. However, the perspective changes by extending the time period when the cost of owning cable circuits exceeds the lease rates. A more effective means of masking monopoly profits is to expand the capital base and, indeed, the incentive to pursue this policy is present. As circuits are leased and put into service the spread between the rate of return and the cost of capital widens. The inducement to conceal monopoly profits earned in the provision of voice communications services is enhanced. Further, by leasing satellite circuits AT&T will be in a position to demonstrate that additional cable capacity is required to maintain a balance

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[2] ITT Cable and Radio, Inc.--Puerto Rico, et al., 5 FCC 2d 823 (1966).

between the two communication systems.[3] AT&T can use satellite circuits to generate additional profits and extend its operations by expanding cable installations. Behavior of this kind will shield AT&T's monopoly profits in international voice communications by increasing non-capital expenses and by increasing its rate base. Continued use of cables is assured by expanding cable investment that, in turn, secures the dominant AT&T market position.

The lease rates for satellite circuits may not accurately reflect the cost of providing satellite circuits and result in a distortion of investment behavior. Intelsat allots satellite capacity to Comsat which then leases circuits to authorized users. If the circuit lease rate is artificially maintained at a high level, AT&T may find that the cost of owning cable circuits is less than the rate paid to Comsat for leasing satellite circuits. In consequence, the incentive to use satellite circuits is curtailed. Cable owners may then have an incentive to expand cable facilities in order to meet increasing requirements because Comsat is the sole U.S. firm providing satellite services.

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[3] There is some pressure on the Commission, most notably by AT&T, to ensure a balance of satellite and cable circuits. This balance is promoted by investment authorizations and two recent cases, TAT-5 and the Puerto Rico decisions, tend to promote this balance philosophy.

The behavior of each firm, stemming from regulatory incentives and the preference for a particular technology, may produce incentives that result in suboptimal investment decisions. Each firm may have an incentive to overexpand its capital in order to satisfy the constraint placed on its rate of return. Traffic may well be divided on an arbitrary basis and decisions made on the basis of compromises deemed fair and equitable. The result could be an excessive amount of capital relative to the quantity needed for an optimal communication network. Furthermore, the investment behavior of each firm, as part of its overall market strategy, may be concerned with pursuing objectives that are not mutually consistent with the other firm's or with system optimization. As a result, coordinating the separate segments to produce an integrated communication network may be subordinated to the goals of the firms. Each firm desiring to expand its market opportunities, but unable to choose between the two technologies, cannot be expected to base its investment decisions on the same grounds as a single firm in a position to choose between alternatives. Other things being equal, a firm with a choice would tend to select the least cost alternative. Acting as adversaries in the provision of communication facilities, AT&T and Comsat may opt for firm strategies that result in overinvestment and a mix of facilities at odds with a system optimizing combination of cables and satellites. In order to determine the possible impact of capital additions on system optimization the investment policies of AT&T and Comsat will be examined along with the criteria of the FCC used to evaluate investment applications.

AT&T: General Policy in International Communications

The general policy of AT&T in providing international communication services can be synthesized from its filings with the FCC. AT&T feels that the public interest encompasses a number of factors that should be promoted. The general policy considerations influence AT&T's investment behavior and system optimization as policy is realized in the form of additions to capacity. The primary component of the AT&T philosophy is to meet its public service function of insuring a sufficient number of circuits to meet growing traffic requirements. The objective is not achieved with cable circuits alone. AT&T does not envisage international communications as a question of satellites versus cables. The two communication mediums are viewed as complementary rather than competitive in meeting demand.[4] A reasonable balance should be maintained between satellite and cable circuits. AT&T indicates that

[4]Letter dated October 30, 1967, from Richard R. Hough, Vice President, AT&T to Rosel H. Hyde, Chairman, FCC.

an equal number of satellite and cable circuits is the proper balance.[5] Circuit equality should not be construed as a rigid, formal division but rather an approximation that should serve as a general guideline. Circuit balance should be achieved in a general area, e.g., transatlantic traffic, but not necessarily on a point-by-point basis. Additions to existing capacity should be timed to maintain the approximate equality of circuit use between satellites and cables in order to insure this balance.

Closely related to the provision of an adequate number of circuits is continuity of service.[6] Diversification of facilities, both by route and type of transmission medium, will promote the continuity objective. Outages occur for different reasons in cables and satellites. In the event of an outage, the capability to restore service in a short period of time must be present. The risk of outage and a prolonged loss of service is spread and a higher degree of service reliability is assured by providing an adequate number of both types of circuits to account for outage.

AT&T envisages the goal in international telecommunications to be an integrated network and a balance of

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[5]Comments of AT&T in "Inquiry into policy to be followed in future licensing of facilities for overseas communications," FCC, Docket Number 18875.

[6]Application of AT&T for TAT-5, April 1, 1968.

cable and satellite circuits is essential in order to insure a diversification of facilities.[7] Such a network will result in an efficient configuration of facilities, maintain service integrity and continuity of service, provide the flexibility desired for protection against failure and flexibility in the assignment of service to circuits, and promote an orderly development of diverse media.[8] In addition to maintaining the best service, a balanced, integrated network will provide the United States carriers with the necessary flexibility when dealing with overseas correspondents. The U.S. carriers cannot act unilaterally; they must accommodate the views and policies of the correspondents regarding the types of facilities to be provided for international services. U.S. leadership in cable technology is also promoted if continued and expanded use of the submarine cable is part of the policy adopted for international communication.

AT&T: Investment Determinants

AT&T sees its investment decisions as part of a planning process in meeting the needs for communication service. Regarding a recent cable project

> the proposal to proceed with the TAT-5 cable is the result of an orderly planning process which goes on continuously in the international

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[7] *Ibid.*, p. 10.

[8] *Ibid.*, pp. 10-12.

> communications industry. In fulfilling our responsibility to provide good service to the public, we have been working with our overseas correspondents for over 40 years on methods to augment and improve international services. Toward that end we are continuously planning ahead to insure that efficient and economical facilities will be available to meet service needs as they develop. One of the prime considerations in this planning is the judicious use of different types of facilities to provide diversification which is so important to continuity of service. The planning for the TAT-5 cable has been part of this orderly and prudent process.[9]

There are a number of specific factors that enter AT&T's decision calculus when contemplating the installation of a new submarine cable as part of this planning process. There are three primary elements and a number of supplementary considerations reported by AT&T.

The first factor is the need or demand for service. New facilities are planned to provide service almost on demand so that service is not interrupted or demand not satisfied because of a shortage of circuits. Due to the lead time necessary for the completion of a cable project (approximately two years for the TAT-5) demand must be projected a number of years into the future. Estimates are compared with the number of circuits available to meet demand. A comparison of capacity with expected demand indicates anticipated circuit shortages during peak load

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[9] Letter dated November 9, 1967 from Richard R. Hough, Vice President, AT&T to Rosel H. Hyde, Chairman, FCC.

periods. The quality of service during peak hours is weighed against the existence of excess capacity during the off-peak period. Demand estimates determine the timing and need for additional circuits. As pointed out in its TAT-5 application, a critical shortage of circuits was anticipated in early 1970 for transatlantic traffic if additional capacity was not installed.[10]

The second major element is the provision of reliable, high grade facilities to a country or area where no facilities exist.[11] This factor was an important consideration in AT&T's decision to propose the TAT-5 cable. No modern cable existed between the U.S. and southern Europe prior to its installation.

The third factor to be included in the decision making process is the economic viability of the new cable.[12] The primary concern is not that the project make an immediate return but rather that the cable system provides an opportunity to earn a reasonable return on the investment over a reasonable period of time.

In addition to these three primary elements, other factors are given some weight in arriving at a decision to undertake a project. However, they are secondary in

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[10]TAT-5 Application, op. cit., p. 9.

[11]Letter dated February 17, 1970 from H. H. Joyner, General Manager, Ocean Cables, AT&T to author, p. 3.

[12]Ibid., p. 3.

importance. One is national security.[13] The relevance of national security varies with the destination of the cable and its significance is conveyed to AT&T by the U.S. defense agencies. The substantial military installations in the Mediterranean area combined with a preference for cable circuits led the defense agencies to emphasize the strategic importance of communications to this area. These agencies expressed a desire to have their requirements satisfied by TAT-5.[14] A second element involves the foreign terminal point. The country where the cable terminates must be politically stable and receptive to the installation of a direct submarine cable link to the U.S. and beyond.[15] Finally, there is the question of whether communications needs may be best served by other means.[16] For example, it is not feasible to directly service the east coast of Africa with a submarine cable from U.S. shores. If the needs are great, AT&T must defer this responsibility to satellites or high frequency radio.

Closely related to the investment decision is the activation of new circuits to a particular point. In this instance, the decision does not involve undertaking a new

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[13] TAT-5 Application, op. cit., p. 11.

[14] Ibid.

[15] Joyner, op. cit., p. 3.

[16] Ibid.

cable project. The decision involves a choice between leasing a satellite circuit or activating an existing cable circuit, where excess capacity is present on both mediums. An analysis of the speed of service, no circuit conditions experienced during various periods, holding time on calls, and quoted delays establish the need for additional circuits.[17] If circuits exist in both systems, the choice is made on the basis of circuit balance,[18] i.e., the objective is to maintain a reasonable balance in order to obtain the best effects of diversification.[19]

If additional circuits are needed to a particular point and one system is being fully utilized, traffic growth could be satisfied with circuits available. For example, prior to the installation of TAT-5 growth in traffic requirements was met by leasing satellite circuits because no capacity was available on the existing TAT cables. As satellite capacity is approached, investment becomes the relevant choice.

When making investment decisions in response to changing conditions, AT&T appears to be concerned with promoting an optimal communications network based on a concept of balanced facility usage. The factors AT&T

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[17] Ibid., p. 5.

[18] Ibid.

[19] Ibid.

weighs when considering a new cable undertaking are an integral part of system optimization. Provision for an adequate number of circuits on an economical basis to meet growing requirements as they develop is an important feature of system optimization. The circuits should be part of an integrated communication network using both cable and satellite facilities. The integration of communication mediums adds diversity, flexibility, and reliability that is needed for an optimal network.

Based on AT&T's international policy and its recent domestic satellite plan,[20] AT&T's behavior can be postulated if it was in a position to invest directly in both satellites and cables. In choosing between alternative investment opportunities slight cost differentials would not foreclose the use of either technology. Requirements would be satisfied by a fully integrated network, as AT&T proposes to do by integrating three satellites into its existing domestic communication system. The international network would be composed of satellite and cable circuits in approximately equal numbers. Flexibility, diversity, and service continuity would be maximized by such a network that would be operated to take advantage of the particular benefits of each technology. Additions to capacity would

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[20] Application for a Domestic Communications Satellite System--In the Matter of Establishment of Domestic Communication--Satellite Facilities by Non-Governmental Entities, FCC, Docket Number 16495.

be timed to meet expected growth in demand and in proportions that maintain the desired circuit balance. Even though slight cost differentials may exist between the two mediums, AT&T feels that the benefits to be gained from circuit balance outweigh the added costs.

Circuit balance seems to be the key factor in AT&T's international communications policy. The need to maintain an approximate equality of circuits is not clearly a prerequisite for an optimal communication network. An individual firm, motivated to minimize costs, would not necessarily base an investment decision on circuit balance when alternative investment possibilities exist. In the event that an analysis of comparative costs reveals an insignificant difference between two projects the choice would be made on other factors. Circuit balance may then become a determinant factor. If the cost differential between alternatives is not insignificant, a variation in the mix of facilities would be required to minimize costs. A cost minimizing firm operating in an environment of changing conditions in demand and technology is likely to utilize different combinations of cables and satellites over time. The firm would find it necessary to re-evaluate the cable-satellite mix if one technology shows a clear cost advantage.

Repudiation of the concept of circuit balance need not result in the sacrifice of other desirable properties of a communication network (diversity, continuity, etc.), nor necessarily subordinate them to cost considerations. A cost minimizing firm could achieve the desired properties with a variable mix that is dependent on changes in relative costs of the two technologies.

On the other hand, strict adherence to circuit balance may entail significant private and social costs that could be avoided by varying the mix of facilities without jeopardizing the promotion of other objectives relevant to system optimization. The desire to achieve circuit balance per se, regardless of traffic requirements, could easily result in chronic excess capacity, particularly in light of the rapidly expanding capacities of individual facilities.[21] Circuit balance would be achieved with one or both firms suffering (or benefiting) from overinvestment in its particular technology. The effect would be similar to that described by Averch and Johnson, and, in fact, the circuit balance argument could be advanced in order to achieve overinvestment. The excessive investment in international communication facilities would result in a misallocation of resources between this industry and other sectors of the economy, not to mention the

[21] The most recent satellite generation, Intelsat IV, has a capacity of approximately 5,000 circuits, up from 1,200 in the previous generation. The current cables being installed have a capacity of 845 circuits with plans for a 3,500 circuit cable in the mid 1970's and a 14,000 circuit cable in the early 1980's.

misallocation between the two technologies within the industry. Further, with rates established to insure the viability of investments, the tariff structure may need to be artificially inflated. The effect of higher rates would be a restriction of demand, thereby denying users the benefits of the asserted scale economies possible from intensive utilization.

The TAT-6 application of AT&T exemplifies the burden of a slavish adherence to circuit balance.[22] In this application, AT&T notes that demand continues to grow and all available cable circuits will be in service by 1972. The TAT-6 will be needed, not necessarily to meet additional requirements, but to prevent an imbalance between cable and satellite circuits from developing. The imbalance would be caused by the launching of the 5,000 circuit Intelsat IV satellites. Comsat has indicated that the capacity of the satellites currently authorized for construction will be sufficient to meet U.S. requirements at least through 1975-76, without the addition of another cable.[23] AT&T appears to be justifying an $86,000,000 investment on the need to

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[22]Application of AT&T for TAT-6, August 28, 1970.

[23]Comments of Comsat in "Inquiry into policy to be followed in future licensing of facilities for overseas communications," FCC, Docket Number 18875, Item B, p. 2.

assure circuit balance, in spite of the possibility that significant excess capacity will result.[24]

General adoption of circuit balance as a policy guideline could also have additional adverse long run effects. A firm is likely to have less incentive to vigorously pursue technological advances if it operates with the knowledge that half of the added investment is secure and a larger portion is not likely. Uncertainty is minimized by reducing competitive pressures that would otherwise be operative. The market tends to become a very stable and predictable duopoly with cost advantages effectively neutralized. The advantages accruing to the firm with lower cost facilities are nullified. In short, if the choice between alternative investment opportunities based on minimum costs is relinquished in favor of circuit balance then system optimization may be seriously impeded.

AT&T: Depreciation Policy

An integral part of AT&T's investment policy is the provision made for the periodic write-off of cables, i.e., depreciation policy. The practice of AT&T is fairly straightforward but assumes added importance in

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[24] In its decision on the TAT-6 application in July, 1971, the Commission dismissed the application on the grounds that the cable was not the most technologically advanced facility and the satellite could better satisfy anticipated requirements. Overseas Communications, 30 FCC 2d 571 (1971).

light of the rapid advances being made in international communication technology and the extremely durable nature of submarine cables.

Each cable and the TASI equipment are depreciated on a straight-line basis over a twenty-four year period. The time period is based on the expected useful life of the facility as determined by engineering judgment. Since service life is an estimate, a given facility could be retired before the time period has expired or its life extended beyond the twenty-four years.[25] To date, none of the TAT cables have been retired nor does AT&T contemplate any premature write-offs in the near future.[26] The existing cables provide high quality service and will remain operational as long as they are needed to meet traffic requirements and can do so at reasonable costs. In the event that maintenance costs become excessive or some other unexpected factors make it uneconomic or unwise to continue service with any existing facilities, they would be retired. Retirement would be accomplished by crediting the original cost of the cable to the Telephone Plant in Service Account and debiting it to the Depreciation Reserve Account. This practice of retiring a facility provides for full recovery of the original investment cost. Even though the reason for the retirement may be economic obsolescence caused by the

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[25] Joyner, op. cit., p. 2.

[26] Ibid.

introduction of technologically advanced equipment and an unrealistic depreciation policy, no risk is assumed by AT&T for its investment decisions. The monopoly market position of AT&T allows it to shift the burden of obsolescence onto the consumer in the form of increased future charges.

The installation of new cables has no effect on the depreciation of existing cables.[27] The new facility is added to the rate base along with the other cables and each cable is depreciated individually, in accordance with depreciation methodology approved by the FCC. All cables are utilized to meet existing traffic requirements even if the new cable has sufficient capacity to service all traffic. The older cables are used on an equivalent basis with the new one and not relegated to a standby basis. Furthermore, regardless of the technological advances embodied in the more recent cables, no form of accelerated depreciation would be applied to the older facilities, even if it is installed between the same points.[28]

Comsat: General Policy in International Communications

The general policy of Comsat is largely prescribed by the Satellite Act of 1962 and influences its investment policy. Comsat, as manager of Intelsat, is entrusted with the responsibility of developing, as rapidly as possible,

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[27]*Ibid.*, p. 3. [28]*Ibid.*

an efficient global satellite system. This responsibility is not construed by Comsat as a mandate that all communication services should be provided by satellite facilities. As with AT&T, Comsat does not consider the provision of communication facilities as a matter of cables versus satellites. Both mediums are necessary and should be used in a complementary way in order to take advantage of the benefits inherent in each technology.

In meeting the obligations of the 1962 Act and satisfying the need for additional facilities to meet traffic growth, Comsat advocates a policy based on comparative system costs. When a choice is being made between installing a cable or orbiting a satellite, the decision should be based on the lower cost alternative consistent with traffic requirements. Comsat has argued that satellites are preferable on the cost criteria. The satellite system should

> be allowed to realize its potential economy through optimum utilization, without being weighted down--at least in its early period of growth--by diversion of traffic to an unneeded TAT-5 cable. We oppose any compromise solution in the Atlantic which would handicap the economic capability of satellite communications and water down the commitment of the United States to the lowest cost communications for developed and less developed nations alike, many of whom may never have cable service.[29]

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[29] Cover letter dated October 30, 1967 to Rosel H. Hyde, Chairman, Federal Communications Commission, from James McCormack, Chairman, Comsat for "Comsat's Response to an Inquiry from the FCC Regarding Future Communications Facilities in the Atlantic Basin Area."

Comsat believes that adoption of the cost criteria will stimulate attainment of the foreign policy obligations in making satellite communication available to developing nations. Only intensive utilization, unencumbered by unneeded facilities, makes this commitment possible. The goal of low cost communication, as viewed by Comsat, is critically dependent upon investment decisions. If investments are made in a manner that insures a high fill factor for satellites, then scale economies will be realized and lower rates are possible.

Comsat: Investment Determinants

The need for specific satellites is determined primarily by anticipated capacity requirements.[30] Although Comsat depends upon the common carriers for actual leasing of circuits, estimates of the demand for satellite circuits are projected. The various ICSC Working Groups estimate future requirements. The results appear in the form of the ICSC Data Base which includes the common carriers' projections as well as the expected traffic between non-U.S. countries using satellite facilities. Long period growth in traffic requirements is extrapolated at an average of 15-18 percent per year.[31] Comsat's aim is to expand

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[30]Letter dated February 24, 1970 from Louis D. Hinton, Director, Rates and Revenue Requirements Division, Comsat to author, p. 5.

[31]*Ibid.*, p. 1.

capacity ahead of expected demand in order to have sufficient facilities in service as requirements develop and not be confronted with a shortage of circuits.

While capacity requirements appear to be the primary determinant of investment, other factors do enter the investment decision. One is Comsat's desire to orbit satellites with enough circuits to insure uninterrupted service.[32] Television transmission is provided on an occasional use basis and requires a large number of circuits, upwards of three hundred. When Early Bird was the sole satellite, other service had to be curtailed to allow television transmission. With larger capacity satellites, proper planning removes the need to curtail some services. Another factor is high launch costs.[33] Comsat would prefer to orbit large capacity satellites. The larger satellites have an increased payload that requires more thrust in the booster rocket. Hence, the launch costs rise with the weight of the satellite. A trade-off exists between increased circuit capacity and increased launch costs. Historically, the larger satellites have resulted in lower investment costs per circuit at capacity.[34] A final element is the advancement of satellite technology.[35] Comsat believes that satellite launchings act as an incentive

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[32] _Ibid._, p. 5.

[33] _Ibid._

[34] _Ibid._

[35] _Ibid._

to future refinements and enable the firm to evaluate present techniques.

Comsat grants the need for both cable and satellite facilities to meet requirements, but the factors this firm reportedly evaluates in its investment decision making do not appear to indicate a concern with the integration of the separate segments into an optimal communication network. The need to furnish sufficient capacity to meet expected demand is a primary consideration. Comsat appears to believe that satellites should be used exclusively to satisfy demand.[36] The determining factor in the cable-satellite issue should be relative costs and any diversion of traffic away from satellites will nullify the cost advantage attributable to satellite communication. The logic of this argument is that if satellite costs are lower, as Comsat states, all investment should take this form. Unless comparative costs vary between systems, over time, both types will not be used.

Relative costs of cable and satellite facilities are certainly relevant to the establishment of an optimal communication system. However, as noted in the discussion of AT&T's investment criteria, relative costs should not

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[36]This position can be inferred from a reading of Comsat filings with the FCC. In particular "Comsat's Response to an Inquiry from the FCC Regarding Future Communication Facilities in the Atlantic Basin Area," October 30, 1967 and Comments of Comsat in Docket 18875, September 14, 1970.

be the sole factor to be considered. System optimization and minimum cost may not be synonomous. Other factors such as system flexibility, diversity, and provision for continuity of service must be weighed in the investment decisions.

Furthermore, sole reliance on comparative costs will not necessarily promote system optimization; indeed, dependence on one factor may even retard its achievement. The possibility of realizing low unit costs from intensive utilization of a facility depends on sufficient demand. If the capacity of a facility is so large that excess circuits exist in substantial number during most of the service life, cost comparisons lose much of their relevance. The excess capacity becomes a burden on users who are forced to pay rates on a facility that may be used at a low level of capacity over its entire life. Owing to its large capacity, a facility may be used at a high level of capacity only during its last year of service and at an average rate of 40 percent over the entire life. An investment decision based on comparative costs alone could result in substantial overinvestment. The possibility of overinvestment is more likely to occur when the cost comparison is made on the basis of capacity unit costs without regard for demand requirements. An anomolous consequence could result from this type of comparison. Scale economies may favor the largest capacity facility, generally a satellite, and only be possible with the large size. However, the rate structure needed to make such a facility viable could be higher than the rate structure required for a smaller capacity cable displaying higher capacity costs. In this case, the scale economies of the larger facility would be superfluous and may lead to an incorrect investment choice.

Satellites are more susceptible to this possibility of chronic redundancy because their capacity is relatively large and their service lives short. As a result, potential economies of scale may not be realized if growth in demand is unable to produce a high load factor. System optimization is concerned with low cost but not to the neglect of an optimum size plant under prevailing and reasonably expected demand requirements. A low rate structure resulting from low costs as overhead is spread among an increased number of circuits is unimportant if actual utilization remains at a low level of capacity for an extended period of time. The biggest may not be the best.

Comsat: Depreciation Policy

The general depreciation policy of Comsat is similar to that of AT&T but there are some differences, primarily due to the nature of satellite systems. Depreciation of all satellite system equipment is straight line, on the basis of expected life. The time period is telescoped relative to submarine cables and varies with the type of equipment. The expected life of satellites is increasing with each new generation but it is only five years for the present Intelsat III satellites. Associated with each generation of satellites are program costs that are depreciated over the time period the particular generation is in service. The period is longer than the expected life of any given satellite in the generation, e.g., the Intelsat III satellite has an expected life of five years, but the program costs associated with this satellite generation are depreciated over seven years, the period of time the Intelsat III generation will be in service. Earth stations are depreciated on the basis of a composite rate of eleven years.

Straight line depreciation of the expected service life is applicable to all satellites regardless of whether they fail, are retired early, or are full life.[37] The capital cost of a satellite is included in the rate base upon initiation of service and remains until it is fully depreciated. No provision is made for accelerated depreciation if an orbiting satellite is replaced by a more advanced one or if there is a failure that precludes further use of a satellite.[38]

There is a difference in the treatment of satellites and cables in one respect. When a satellite is

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[37] Hinton, op. cit., p. 4.

[38] Ibid.

replaced by a new, larger one, the two are not operated in tandem. All commercial traffic is transferred to the new satellite. For example, when Intelsat III-F-2 was launched, it assumed the traffic carried on the existing Intelsat II-F-3. Satellite technology requires this type of operation because two satellites cannot operate simultaneously with the same earth stations without a second antenna at each station. Traffic between two other earth stations could be carried over the pre-existing satellite. Alternatively, the original satellite could be used as an inactive spare or transferred to another orbit. Regardless of the alternative taken, depreciation continues on the original straight line basis over the expected life of the satellite.

FCC Evaluation of Investment Proposals

Under Section 214 of the Communications Act of 1934 the international common carriers must receive approval from the FCC before undertaking international projects that terminate on United States territory. The FCC has the final power to authorize additional satellites, U.S. earth stations, and cables. The impact of additional cables and satellites on the public interest and system optimization is, to a large extent, determined by FCC decisions in the exercise of its authority. The criteria governing the evaluation and authorization of new facilities by the FCC must be examined in order to determine the impact on system optimization.

A number of factors are reportedly evaluated by the FCC in analyzing investment proposals of AT&T and Comsat. Particular factors may vary with individual projects but, in general, the following elements enter into the final decisions:

> the projected traffic volume; the capacity of existing and proposed facilities designed to meet requirements; the time when each of such proposed facilities may reasonably be expected to be available; the potential benefits of the availability of different media to furnish service; investment and operating costs; the revenue requirements which might be reasonably expected to be applicable to the various proposed configurations of facilities; the proposals made with respect to charges to the public for telecommunications services; the established U.S. policy favoring the earliest possible implementation of a global communications system via satellite; the views of interested foreign entities insofar as available; and the long-range needs for adequate and efficient facilities to provide communications services to all parts of the world.[39]

Other factors are also relevant to the FCC decisions. The public interest in a strong, efficient communications network is said to benefit from diversity of facilities, ability to meet national defense and security requirements, spare capacity to insure continuity of service, encouragement to continued technological progress prompted by the probability of expanded use, and the opportunity for rate

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[39]Letters from the FCC to AT&T, Comsat, ITTWC, RCAC, and WUI, February 16, 1968, 11 FCC 2d 957 (1968), p. 957.

reductions as circuit costs fall.[40] The factors weighed in FCC decisions concerning investment proposals are all acknowledged in various opinions.

Another factor, not specifically stated but implicit from FCC action, is a policy of maintaining a reasonable balance between satellite and cable circuits that is reinforced by a companion policy to insure usage of satellite facilities, i.e., the proportionate fill policy. Two recent cases indicate that the FCC favors a policy of balanced growth of satellite and cable facilities.[41] The Puerto Rico decision originally appeared to be a confrontation between satellites and cables that would necessitate a choice between the alternatives. The proposals submitted by AT&T and Comsat indicated that only one application could be justified. However, further review of the available data altered the original positions of AT&T and Comsat and, apparently, the FCC because both applications were approved. Rather than one additional facility, a 720 circuit cable was approved for installation and the construction of an earth station was sanctioned.

The second case involved the TAT-5 cable. AT&T sought the installation of a 720 circuit transatlantic

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[40]American Telephone & Telegraph Company, 13 FCC 2d 235 (1968), p. 242.

[41]The two decisions referred to are the TAT-5 cable authorization and the Puerto Rico decision that authorized a cable and an earth station.

cable on the grounds that expected growth in demand required additional circuits and these circuits should be in the form of a cable in order to avoid a future imbalance of circuits. Comsat, on the other hand, argued that the proposed cable would be an unnecessary investment that would divert traffic away from satellites and be a burden on users. The FCC was apparently convinced by the arguments of AT&T because it authorized the installation of TAT-5.

There is little doubt that the criteria of the FCC for evaluating investment proposals for additional satellites and cables encompasses many public interest considerations that must be weighed in order to reach a decision. Investments that are approved to meet increasing demand as it occurs, assure continuity of service, increase diversity, etc., promote the public interest. However, it is significant to note that in the Puerto Rico and TAT-5 decisions, the costs incurred by the firms for additions to capacity are relegated to a minor role. In fact, in the Puerto Rico and TAT-5 decisions the question of comparative costs between the alternatives is side-stepped completely. The Puerto Rico case discusses costs but in approving both applications the cost issue became irrelevant.[42] In the

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[42]The extent of the discussion of costs in the Puerto Rico decision is a comparison of AT&T annual carrying charges and Comsat lease rates. On this basis a significant differential is noted between owning a cable circuit and leasing a satellite circuit. AT&T estimates that the annual carrying charge of the proposed cable will

TAT-5 decision the concurring majority did

> not believe that any useful purpose would be served by going over relative costs or the revenue requirement data filed by the interested parties in response to the Commission's informal inquiry. In any event, our decision to grant these applications is based on the above broad spectrum of considerations.[43]

The "broad spectrum" did not include cost comparisons because the Commission did not feel that it was necessary to choose between cables and satellites. The Intelsat IV satellites were not scheduled for completion in time to satisfy the expected growth in demand that would exceed available capacity.

The concept of system optimization deals with more than a comparative evaluation of accounting costs presented by the firms in their applications for new facilities and authorization of the lowest cost facilities without regard to other factors. However, in authorizing an addition to existing facilities, some emphasis should be placed on

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be $7,500 per circuit, before an allocation of administration expenses. The rental charge for a satellite circuit is estimated at $30,000 per year. These figures are important not for choosing between two alternatives but in order to insure economic viability. Further, in spite of the fourfold difference, both the cable and the earth station applications were granted on the grounds of sufficient traffic. The TAT-5 decision bypasses any consideration of comparative costs. The decision states that a choice is not being made between a cable and satellite. Therefore, no definitive findings on comparative costs are necessary. In a strongly worded dissent, Commissioner Nicholas Johnson takes issue with this conclusion and states that a decision cannot be justified without considering comparative costs.

[43]AT&T, op. cit., p. 242.

evaluating investment proposals in order to determine the least cost alternative, particularly if the project is very durable and relatively inflexible. If significant cost differentials are found to exist between alternatives, the lower cost project would be preferred for authorization. In the event that the high cost project is approved, it must be justified by overriding non-cost considerations that cannot be met by the lower cost investment. In short, it must be presumed, a priori, that the low cost alternative will be adopted, other things being equal, and therefore, an analysis of cost figures is mandatory.

Implications of AT&T and Comsat Investment Policies

There are a number of implications that can be drawn from the investment policies of AT&T and Comsat and their potential impact on the attainment of an optimal communications network. One particular aspect for analysis is the depreciation policy of the two firms.

The provision made for the depreciation of satellite and cable facilities should make allowances for gradual deterioration in the process of providing service and for the possibility that "facilities are rendered obsolete by new technology, are made inadequate by growing demand, or are made useless by changes in public requirements."[44] The allowance for a periodic write-off of equipment reflecting technological advances is particularly important in the international communications industry due to the rapid advances in new cable and satellite facilities and the long service life imputed to cables. AT&T notes that technological developments have resulted in significant reductions in cable costs:[45]

TAT-1	$305 per circuit mile
TAT-3	94 per circuit mile
TAT-5	30 per circuit mile
SG Cable	8 per circuit mile (projected)

Comsat acknowledges a significant downward trend in satellite investment cost per circuit with each new generation of satellites.[46]

In the presence of significant cost reductions and rapidly expanding demand, AT&T and Comsat continue to use straight line depreciation that provides for an equal annual reduction of original investment costs. The use of straight line depreciation by AT&T and Comsat in a market subject to continuous growth of demand that necessitates significant periodic additions to capacity embodying cost reducing advances may be contrary to the economic realities. The

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[44] Charles F. Phillips, Jr., The Economics of Regulation (Homewood, Illinois: Richard D. Irwin, Inc., 1965), p. 191.

[45] AT&T, op. cit., p. 3.

[46] Comsat Comments, op. cit., Item B, p. 12.

service life of facilities, particularly cables, is relatively long and, apparently, little consideration is given to the possibility of economic obsolescence. The twenty-four year service life imputed to cables appears to be based primarily on physical life and, in all likelihood, a given cable will be superseded by advancements introduced prior to retirement. Anticipation of technological advances should be reflected in higher rates of depreciation in the early life of the cables that will more closely approximate the economic cost. The recognition of increases in productivity stemming from technological improvements will tend to eliminate differences between historical and current costs by reducing the net book value of old assets to reflect the productivity values of the latest technology. In consequence, the rate base is larger than it would be with a more realistic provision for depreciation because capital facilities remain in service for their entire expected lives or at inflated book value. Allowance for obsolescence may, of course, increase the annual depreciation expense in early years of facility life with a corresponding reduction in later years. AT&T, for example, apparently has no intention of retiring any TAT cables prior to the end of their estimated twenty-four year service lives even though TAT-5 has been installed. Another 825 circuit cable is proposed for 1972, and a 3,500 circuit cable is planned for 1976. Each of these cables exhibits a significant cost advantage is comparison with current facilities. However, AT&T does not anticipate any alterations in the depreciation practices for existing cables.[47]

The potential benefits from technological improvements embodied in the newer cables and reflected in lower circuit costs may have been largely diluted by depreciation policies and the continued use of older cables. The reduction in circuit costs of new facilities is juxtaposed with older, higher cost facilities resulting in a mix of high and low cost cables. Failure to reconcile the disparity between historical costs and current costs with a realistic depreciation policy produces an average circuit cost of the total cable plant that is a function of cable facilities embodying different stages of technological advance. Each cable has a separate average cost that is influenced by cable capacity. The implication of retaining older facilities and lumping them together is to raise the long run average cost of circuits and partially nullify the realization of lower costs made possible by advances in newer facilities. The actual long run average cost curve is altogether different than the typical envelope curve.

The long run effect of the type of behavior discussed is not unlike the behavior postulated by Averch and

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[47]Joyner, op. cit., p. 3.

Johnson. Rather than expanding the rate base by substituting capital for variable factors, the rate base is maintained at an inflated level by continued use of older equipment and a conservative depreciation policy. New, improved facilities are added to existing equipment. The result is an ever-increasing stockpile of economically obsolete equipment. The obsolescence is reflected through higher historical book costs than would be borne by employing more advanced techniques with lower current costs or recognizing the impact of technological advance by employing more realistic depreciation practices.

The market structure in international telecommunications, in conjunction with rate of return regulation, is not conducive market pressures that will lead to either revaluation or removal of equipment that is obsolete but not physically defunct. Pressures to adopt cost saving innovations and capital saving equipment are weak because of AT&T's position vis-a-vis Comsat and the apparent need for additions of cable and satellite facilities. In the absence of compelling market forces, innovation is likely to proceed at a slower pace producing an upward bias in costs. The firms benefit because market shares tend to stabilize, the uncertainty inherent in innovation is minimized, and future additions to capacity by each firm are assured, provided demand continues to grow. The incentive to make adjustments is further impeded by the dependence of absolute profits on the size of the rate base. This relationship between profits and capital encourages the use of capital, consistent with the rate of return. The rate base can be increased by retaining older equipment and investing in new facilities. Under the circumstances, AT&T will be reluctant to write-off a cable that is obsolete. Further, by installing one cable after another, AT&T has been able to expand its rate base while insuring its position of dominance by continued use of cable circuits.

The incentive to remove equipment that may be obsolete is further restrained by AT&T's pricing policy. In establishing overseas rates AT&T includes its investment and operating expenses for all facilities, i.e., cables, high frequency radio, satellite equipment, and domestic distribution systems.[48] The FCC, in attempting to insure users that the expected economies of satellite communication would be reflected in rates, established a policy of composite rates based upon satellite and cable costs. The realization of economies in satellite usage is expected to redound to the consumer with this pricing policy. But the pricing policy of AT&T continues to be one of price averaging. The composite rate formula makes it virtually impossible to reflect the unique characteristics of satellites and tends to neutralize the impact of technological advances on rates. The magnitude of this

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[48] _Ibid._, p. 4.

neutralizing effect can be roughly approximated by noticing the anticipated impact of TAT-6. The annual revenue requirements per half circuit for the TAT-6 cable are estimated by AT&T to be about $8,600. Averaging this cable in with the existing five TAT cables produces an estimated average annual revenue requirement per half circuit of $16,600.[49] Those figures are for cables only and are for revenue requirements which are not the same as rates. However, the effect of averaging can be appreciated.

With rates based on an average of high and low cost facilities there is a real possibility that the costs of older facilities may not be entirely covered. However, the detrimental effect of older cables being non-remunerative is avoided by establishing rates on the basis of the revenue requirements of all vintages of equipment. The more advanced facilities are then subsidizing higher cost equipment and AT&T does not suffer any ill effects from using obsolete equipment or an unrealistic depreciation policy. The costs of using obsolete equipment can be passed on to the consumer through price averaging due to AT&T's monopoly in international voice communication at the expense of potentially serious resource misallocation.

The impact of continued reliance on older, higher cost cables in conjunction with newer facilities will

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[49]TAT-6 Application, op. cit., p. 21.

retard incentives to achieve an optimal network. The contrasting case of a competitive market exemplifies the effects of using obsolete equipment and unrealistic depreciation practices on system optimization. In a competitive market the use of higher cost equipment would be remedied by new entrants. Potential entrants seeing the use of high cost facilities and, realizing that lower costs could be achieved with new facilities, will be attracted to the industry and supply output on the basis of their lower costs. The existing firm would find itself in a position of losing sales to the new entrants. Faced with the prospect of losing all its business, the firm would be forced to adopt lower cost equipment or meet the lower prices with existing equipment and continue production at a loss (which the firm would not endure in the long run). Obsolete facilities are thereby removed and more efficient methods of production are adopted through the interplay of market forces.

Depreciation policies that do not accurately incorporate the obsolescence factor into the annual allowance and pricing policies that are based, in part, on these depreciation policies create the potential for a misallocation of resources. To the extent that system optimization is concerned with efficient resource allocation, a suboptimal communication system may be the consequence of depreciation practices that are unresponsive to technological change. The annual allowance for depreciation of submarine cables over a twenty-four year period does not appear to be realistic in light of the technological advances being made in international communication techniques. Depreciation is understated in early years of asset life and net book values are not written down to the productivity values of current additions to existing capacity. The initial understatement is then absorbed in later years by the equipment that may have become obsolete or is being carried on the books at inflated values and is covered by consumers. The current practices can be expected to continue in the absence of regulatory action or market pressures operating to remedy these inefficiencies.

Interaction of Market Structure, Investment Policies, and Regulatory Policies

Market structure and investment behavior have been discussed separately to this point. The investment policies of AT&T and Comsat do not lead to an a priori conclusion that system optimization is being promoted. Indeed, there is a reasonable presumption that investment policies may actually impede its promotion. Similarly, the current market structure is not conducive to optimizing behavior by the firms. The interaction of market structure, investment behavior, and regulatory policies tend to reinforce each other in a manner that may seriously retard a mix of plant, and allocation and distribution of resources that approximates system optimization in the dynamic international telecommunications industry.

In an environment of rapidly growing demand and cost reducing advances in technology, investment is geared toward meeting expanding traffic requirements through balanced additions of cable and satellite circuits. Other considerations influence investment decisions but demand and circuit balance dominate. The least-cost alternative as a criteria for additions to capacity does not appear to be an important consideration in the overall investment decision. A conservative straight line depreciation policy, in the presence of improving technology, and continued reliance on older facilities with higher unit costs, inhibit the maximum realization of benefits stemming from the lower unit cost of new projects. A policy of establishing rates on a composite average cost of both technologies and all facilities further inhibits the consumer from realizing the full benefits of the technological advances embodied in the newest facilities. In addition, these composite rates shield potentially obsolete facilities from the competitive cost advantage of the newest equipment. Older facilities are further protected by the proportionate fill policy. As new investments are undertaken, the unfilled proportion of cable and satellite circuits must remain approximately equal. New cables do not replace the older, smaller ones but, rather, are used as supplements. The original cables are guaranteed continued use in this way and rates are established at a level that permit a reasonable return on all capital. The need to insure proportionate utilization of circuits in new facilities is symptomatic of structural imperfections and/or investment inefficiencies, e.g., improperly timed additions resulting in excess capacity, cost advantages accruing to one technology or a particular facility that go unrealized, and a preference based on ownership but not necessarily reflected in cost differences, etc.

Reliance on market pressures to correct these impediments to system optimization is futile. The market is artificially segmented between AT&T and the record carriers. The Authorized User decision substantially limits the ability of Comsat to gain direct access to markets and effectively compete with the common carriers. Rather than competing directly for the business of consumers, Comsat must compete indirectly through its competitors, i.e., use of satellite circuits depends on the common carriers and the proportionate fill policy. Thus, the market place is not the final arbiter and the cost advantages of either technology do not determine resource allocation. On the one hand, Comsat depends on the derived demand of the common carriers and proportionate fill for satellite utilization. On the other hand, if cables enjoy a comparative advantage they can only be used to satisfy a portion of the expanding traffic requirements. In short, competitive interplay has been suppressed. This circumvention of competition between the firms that are primarily responsible for additions to capacity can be expected to influence the quality of investment by reducing the pressure to innovate. A potentially dynamic market is stabilized and market structure becomes static. Competitive behavior may give way to "satisficing" corporate behavior that impedes innovation and change over time.

It is not possible to determine with certainty or precision how market structure and investment policies interact to affect the mix of facilities, and resource allocation and utilization in the transatlantic network. However, the communications network can be examined, over time, to see the end result of the interaction.

CHAPTER IV

EMPIRICAL ANALYSIS OF THE TRANSATLANTIC NETWORK

Ideally, satellite and cable facilities should be integrated to form a communication network that can meet communication requirements at low costs. The discussion of market structure and investment behavior suggests the presence of tendencies that may systematically retard the realization of low cost service. The present chapter examines the individual facilities composing the transatlantic communication network for the years 1965-1970. This analysis supplements the previous discussions by examining the operation of individual cables and satellites in an attempt to determine the impact of the interaction of market structure and investment behavior on the transatlantic communication network. A cross-sectional analysis is used to see how AT&T and Comsat adapt to changes in demand and technology by varying the mix of plant, and the allocation and utilization of resources. The responses of the firms to changing conditions are investigated for evidence of inefficiency and misallocation of resources, unused indivisibilities, substantial cost differentials among facilities, and other factors that tend to impede cost reductions and are contrary to system optimizing behavior.

Two measures are applied to the individual cable and satellite systems. One measure is annual unit accounting cost estimates. The other is an output-input index. Each measure is described briefly after a discussion of the difficulties encountered with the application of conventional economic analysis.[1] Both measures are subject to shortcomings and these are discussed. A number of difficulties exist in applying the measures to cable and satellite facilities. These problems are examined at some length and the basis for the analysis is presented. The empirical findings on each cable and satellite are then presented and discussed. The final section is devoted to a discussion of the structure-conduct implications of the empirical results.

Description and Purpose of Measures

The equilibrium conditions of a multiplant firm indicate that an efficient, internal allocation of resources is achieved by the equality of the marginal cost curves with the marginal revenue curve. If this condition is not satisfied costs can be reduced by reallocating output from the plants experiencing higher marginal costs to

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[1]A more thorough description of the calculations for the two measures is presented in Appendices A and B.

those plants with lower marginal costs. Ideally, an examination of resource allocation and utilization of communication facilities would investigate the marginal cost functions of each cable and satellite facility. A comparison of the marginal cost incurred by each plant in supplying its level of output would indicate whether traffic requirements were being satisfied in a manner that minimized costs.

However, an equilibrium analysis is too narrow in perspective for the issues under consideration. Further, the time frame is inappropriate. The long-run marginal cost concept is future oriented, emphasizing planning decisions and choosing among alternative investments. The marginal cost concept involves an evaluation of specified alternative courses of action and levels of output that are available to the firm at a point in time. The immediate issue focuses on an assessment of past investment decisions and operating procedures in light of actual events. These past decisions embodied assumptions and forecasts of such variables as demand and the time allocation of capital costs and revenues to particular future time periods. At issue is the accuracy of the assumptions and forecasts in light of reality. If significant errors have been made by the decision-makers these errors will be reflected in an evaluation of existing facilities, not in the derivation of long-run marginal costs. Only then can adjustments be made in the underlying assumptions and forecasts so as to more closely approximate reality.

An alternative approach for appraising the operation of the transatlantic communication network is followed. The approach is more consistent with the historical perspective. Rather than applying equi-marginal analysis, two measures are derived. One is an estimation of the annual unit accounting cost of each facility. The estimation of these unit costs over the 1965-1970 period will permit a number of interesting observations to be made and tendencies indicated regarding the operation of this communication network as an integrated unit. In conjunction with fill factors, the direction of unit costs can be determined as utilization varies from year to year. Significant differences in unit costs among the facilities may exist. Further, a trend in unit costs with the introduction of advanced techniques and/or more intensive utilization may become apparent. Each of these factors is important to the provision of communication services at low cost. Simultaneous operation of facilities exhibiting noticeable differences in unit costs tends to indicate that communication users are not receiving the maximum benefits possible. This consequence is magnified if reliance on higher cost methods is expected to continue in the absence of remedial action. Such a course of events is contrary to the promotion of system optimization to the extent that low cost communications service is a primary objective.

The unit cost measures are supplemented by the derivation of output-input indices. The output-input index is an indicator of productivity and is used to evaluate the individual facilities on a second basis. Since capital is the dominant factor of production in both mediums and it is the input under examination, the measure will be a partial productivity index. This index is applied to individual facilities and, basically, it measures the average product of capital.

The index is used in an attempt to identify significant differences in the productivity of the various facilities used in international communication. If significant productivity differentials exist, the next area of inquiry is whether or not these differences appear to have any influence on the operation of the communication network. Sizable differences in productivity among facilities may be indicative of a number of tendencies. A given generation of equipment may have been surpassed by innovative techniques. Failure to incorporate technological advances may be the result of insulation from competitive pressures stemming from the existing market structure. Or, vested interests of the firms may cause a reluctance to exploit the advances embodied in new capital. Existing investments may be jeopardized and if a firm can control this threat without suffering the ill effects of a reduction in its business, the opportunity will be exploited. Again, this type of behavior stems from the market structure. Another possibility is that productivity differences may be caused by insufficient load factors. Persistent excess capacity may be indicative of poor investment timing, overly optimistic demand forecasts, an absence of integrating different facilities that form the communication network, and so on. These types of tendencies are all indicative of non-optimizing performance in the industry.

It may appear that the annual unit cost measure and the output-input index are simply variants of the same measure. The cost measure examines average cost while the productivity index looks at average product. The results should, therefore, be consistent and in agreement because one measure appears to be a mirror image of the other. However, there is a fundamental difference between the measures. The difference lies in the unit used to measure output. For unit costs, a voice-grade circuit serves as the unit of output. The productivity index measures output in terms of actual communication transmissions, e.g., telephone messages, telex, telegraph, television, etc. There is no reason to assume, a priori, that these two methods of measuring output will yield the same results. A voice-grade circuit can serve as a common indicator of capacity for cables and satellites. This unit of capacity can also indicate the number of circuits in service during a given time period. However, the voice-grade circuit does not measure the usage of a facility for the time period. For example, consider a cable circuit in service between the U.S. and Ireland. The communication traffic transmitted over this circuit may be very high or only nominal. The fact that the circuit is in service gives no indication of traffic volume. Actual messages more nearly approximate usage of the facilities by measuring traffic volume.

A second difference is that input varies between the two measures. Adjustments are made for price level changes with the output-input index. Similar corrections are not made with the unit cost measures. Thus, the output-input index is in real terms and the unit cost measure is not in real terms. The output-input index is in terms of capital only. Capital input is measured by the sum of annual depreciation and the return on net capital. On the other hand, the unit cost measure is composed of depreciation and operation and maintenance expenses. Therefore, non-capital elements are included. In short, the measures do differ because both the inputs and outputs differ. Agreement of the results will tend to strengthen any implications that can be drawn from the results.

A brief description of the two measures is considered before discussing their shortcomings. More detailed descriptions are developed in Appendices A and B. First the unit cost measure. Historical accounting cost estimates of individual cables, satellites, and earth stations are used to compute the accounting costs per circuit. More specifically, in each year the individual facilities have a total accounting cost composed of depreciation and operation and maintenance expenses (hereafter referred to as O and M). The total of these expense items is the accounting cost associated with the circuits in operation. The number of circuits in service on each facility is taken as the year end total. The ratio of total annual accounting costs to voice-grade circuits is an estimate of the annual average cost attributable to each circuit actually in service. The unit accounting costs measure the annual cost of the two communication mediums for different generations of capital.

The output-input index is slightly more complex. The index is applied on the same basis as the accounting cost measure, i.e., for individual facilities on an annual basis. As previously mentioned, output is not in terms of voice-grade circuit totals. Output takes the form of actual communication transmissions and is allocated among the facilities on an annual basis. Output is valued in base period prices, the base period being 1969. Capital is the sole input entering the index and is weighted at base period prices. The sum of the return on capital elements, weighted by the base period rate of return, and annual depreciation is an estimate of the annual capital input. The ratio of actual output to capital input serves as an estimate of the productivity of capital.

This output-input index is patterned after the total factor productivity index developed by Kendrick.[2] He applied the index to the domestic economy and major segments of the economy in an attempt to measure net changes in productive efficiency and to analyze productivity trends. In conjunction with Creamer, the productivity concept was also applied to individual firms.[3]

Shortcomings of Unit Accounting Cost Measure and Output-Input Index

There are shortcomings associated with the annual cost and productivity measures that must be recognized before proceeding with the analysis of international communication facilities. While it is not the purpose of this section to become involved in a prolonged discussion of the merits of accounting data and their use in economic analysis, it is recognized that there are infirmities in such data. Accounting data do not measure the economic

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[2]John W. Kendrick, Productivity Trends in the United States (Princeton, New Jersey: Princeton University Press, 1961).

[3]Daniel Creamer and John W. Kendrick, Measuring Company Productivity (New York: National Industrial Conference Board, Inc., 1961).

cost or opportunity cost of resources devoted to satellites and cables. In addition, satellite equipment is purchased on a competitive bid basis while some cable facilities (repeaters and, in the case of TAT-4, most of the cable) are manufactured primarily by Western Electric and installed by AT&T. The unit cost figures derived from accounting data will suffer from the same shortcomings.

The data are not used for specific estimation as in a determination of individual rates. Rather, the accounting data are used to determine the relative levels and the trend of annual unit costs of the facilities employed in international communications. The importance of the accounting measures lies in relative levels and not so much in the exactness of individual values. Furthermore, accounting data are available and can be used to investigate the possibility of cost differences among facilities in order to get a fix on the communication network.

The output-input index also suffers from a number of problems. One is the usual difficulty associated with index numbers of selecting a base year. The base period selected affects the productivity trend and the normal procedure in minimizing this difficulty is to compute a number of indices with various base periods. This partial solution cannot be adopted for international communications due to the relatively short period of time cables have been in operation and the even shorter existence of satellite communication. Compounding the problem is the desirability of selecting a base period in which facilities were operated at a high level of capacity and the necessity of a positive return on capital. The primary difficulty in satisfying these two requirements lies with satellites. Comsat did not earn a positive return from operations until 1968 and then it was very low. In the following year, its return increased substantially as did the utilization of its capacity. Unfortunately, the process of elimination dictates the selection of the base year as 1969 and it is the sole period that can be used.

The brief period of time for satellites as a medium of communication creates a problem of interpreting the results. The output-input index emphasizes the long run. The impact of technology on increasing productivity can be best revealed by observing the trend of productivity over time. However, the relatively short existence of satellite communication makes it difficult to establish an obvious trend. Similarly, modern cables have not been in operation for a long period of time. In short, the history of these two communication mediums has not been sufficiently long to enable a clear picture to emerge on any definite long term trends that may be developing. Based on the data for the years available, two generations of satellites and cables clearly indicate the short term movement of the index.

As an independent companion to the unit accounting cost measures, the output-input index can be used for short run inter-facility comparisons, subject to some limitations. In the short run, the indices of individual facilities are likely to be influenced by a number of factors. Among these factors are scale effects, utilization effects, and technological differences among facilities. Each factor influences the value of the index and their interaction makes it very difficult to disentangle the individual effects in order to determine the relative importance of each factor on productivity. The combined impact of these factors can be minimized to some extent by choosing years in which utilization of capacity is high for all facilities. However, the opportunity to select comparable years is constrained by the time frame.

The limitations imposed on the output-input index do not invalidate its application. The purpose for using this index is not to isolate individual causes of productivity change nor to specify the contribution and influence of the main factors on the overall value. The usefulness of the index for inter-facility comparisons is to identify any significant differences in productivity that may be present. In light of the limitations in applying the index to international communications, the importance of the values obtained must be judiciously interpreted. As with the unit accounting cost figures, it is relative levels of the indices that are important and not so much the absolute magnitudes of the differences.

The definition of output and its measurement present another problem. The capacity of satellites and cables is generally stated in terms of voice-grade circuits. But measuring output in terms of circuits gives no indication of usage of the circuits. For instance, satellite circuits are leased by Comsat to the common carriers. Comsat does not transmit over these circuits for the most part. The firm merely supplies transmission facilities. Satellite circuits would therefore, seem to be the output of Comsat. However, leasing satellite circuits does not indicate the extent of their use. The same point is applicable to AT&T although it does serve the final user. Measuring cable output by the number of voice-grade circuits in service suffers from the shortcoming of not indicating actual circuit use. The voice-grade circuit, as the measure of output, is analogous to measuring the output of an airline company by the number and capacity of its planes without regard to the number of passengers it carries. Therefore, circuits are not used as a unit of output.

A second alternative to the output problem is data of the messages transmitted during a one year period. The FCC Statistics of Communications Common Carriers contain rather detailed information of international traffic. On a country by country basis the three basic traffic categories (telephone, telegraph, and telex) are listed in terms of revenue and actual message totals. Private line business for the record carriers and AT&T is also recorded. However, the traffic totals are not given in equivalent terms. Telephone traffic is stated by the number of messages and minutes. Telegraph traffic is in terms of messages and words while telex traffic is in minutes and words. The logical common denominator that permits combining the individual traffic categories into an aggregate total is the dollar value of each one. Total revenue figures for message telephone, message telegraph, and telex are used as an estimate of transatlantic traffic by cables and satellites. Private line traffic is treated differently because of the rate reductions that have been instituted. Leased voice circuits in the years under observation, for example, are weighted by the 1969 lease rates. The revenue totals include traffic originating in the U.S., traffic terminating in the U.S., and traffic transitting the U.S., i.e., traffic that originates outside the U.S. and whose final destination is outside the U.S. but must use U.S. domestic communication facilities. Stating output in terms of revenue allows for the inclusion of other minor traffic categories such as television traffic and NASA traffic.

After concluding that FCC traffic data would serve as an adequate measure of output for the output-input index the problem of traffic allocation to individual facilities has to be solved. The indices are calculated for individual facilities. The data are given in terms of total traffic to various countries. The same country could be served by cable or satellite and by more than one cable or satellite. Therefore, the traffic had to be allocated between cables and satellites and then among the cables and satellites. The allocation method is based on the proportion of cable and satellite circuits to individual countries.[4] The cable traffic was then allocated to individual cables on the basis of circuit proportions for the different cables. A more detailed explanation of the methodology is contained in Appendix B.

Conceptual Problems in Analyzing Individual Facilities

The problems discussed to this point have been problems of measurement, definition, and data. In addition, there are more basic issues of establishing a basis for comparing the two technologies and the different generations. These difficulties transcend the previous ones and are primarily a result of the differences of the technologies.

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[4]In discussions with individuals at AT&T it was learned that the division of telephone traffic between satellites and cables on the basis of the number of circuits in service was a reasonable approximation.

The main problem stems from the fact that a cable is a point-to-point means of communication whereas a satellite is capable of transmitting either point-to-point or to multiple destinations. A cable has one terminal on either side of the Atlantic Ocean. For instance, TAT-4 terminates in Tuckerton, New Jersey and St. Hilaire, France. Transmissions to other countries are routed through domestic communication systems. A telephone call to Germany may go through the domestic communication system of France to Germany. On the other hand, a satellite has the capability to communicate directly with any earth station in the area covered. The same telephone call by satellite need not be routed through France because Germany has its own earth station. Therefore, the call can go directly to the German station at Raisting. Complicating the problem is the fact that the more recent Atlantic satellites, the Intelsat III's, communicate not only with European countries but also with countries in Latin America, South America, and the Middle East. Thus, a satellite assumes coverage that is global in nature. A transatlantic cable is not capable of the same coverage. If communication with South America is desired, in addition to Europe, a separate cable system must exist or a new one installed to South America. For satellite communication, it is only necessary to install an earth station in South American countries or gain access to an earth station.

The problem is one of comparability. It is possible to assume that a satellite will be used for only point-to-point communication. This solution is not entirely satisfactory for two principal reasons. Capacity estimates become unrealistically inflated. For instance, in its recent filing, Comsat estimates that point-to-point capacity is 17,000 half circuits but actual planned configurations for presently authorized Intelsat IV satellites do not exceed 4,000 circuits.[5] Thus, usable capacity tends to be overestimated.

The second reason concerns the number of earth stations. Only two terminals are needed for point-to-point communication. However, many more are actually used. The question arises as to the number of earth stations to be included. If point-to-point communication is rejected as the basis of comparison, should all the earth stations communicating with a satellite be included or only a portion of them? The greater the number of earth stations comprising a satellite system, the higher the unit cost is expected to be. Indeed, the proliferation of earth stations may be a prime factor inhibiting system optimization. Stations erected for very light communication routes add significantly to costs without enhancing satellite utilization a great deal. These stations may be a burden on the

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[5]Comments of Comsat in "Inquiry into policy to be followed in future licensing of facilities for overseas communications," FCC, Docket Number, 18875, Item C.

satellite system as well as the communication network. The tendency toward multiple earth stations is intensified by a desire for national prestige. An earth station may not be economically justified for a small country but the prestige factor may lead to installation of a station. Thus, whereas a group of contiguous countries may be able to justify a single earth station on the basis of traffic requirements, any one country, by itself, may not. Should all these earth stations be included in the satellite cost or only a portion of them, and if a portion how many?

Another problem in establishing a basis of comparison is the differential in expected lives of the two technologies. Cables have twenty-four year lives whereas the lives of satellites vary. Intelsat I had an expected life of 18 months, Intelsat II was to last for three years, and Intelsat III for five years. Most cable-satellite comparisons deal with this problem by assuming that a number of successive satellites are orbited to last for twenty-four years.[6] This assumption equalizes the time period for cables and satellites that is thought to be necessary for a comparative cost analysis. The shortcoming with this approach to equalizing life spans is an inconsistency with actual events. Satellites of the same

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[6]An example of this type of analysis is in "Reports on Selected Topics in Telecommunications," Final Report to the Department of Housing and Urban Development, Revised, 1968.

generation generally are not planned to replace each other. A new generation, embodying technological advances, is usually planned as a replacement. In the case of the five-year Intelsat III, five successive satellites will not be launched at five-year intervals. An Intelsat IV will replace an Intelsat III. The assumption of succession is essentially one of expediency. Cost information on future satellites is very uncertain so data at hand are used.

An additional problem concerns capacity and usage differentials. This problem is particularly significant in interpreting the output-input indices. Cables and satellites are not operated in a similar manner. When a new cable is installed it is operated in conjunction with the existing cable capacity. Utilization of the new cable builds up in response to growing traffic requirements. Unlike cables, the launching of a new generation satellite generally serves as a replacement for an existing satellite. Traffic is transferred from the existing satellite to the new satellite. The initial excess capacity of a new satellite is then reduced as traffic requirements expand. A second factor affecting satellite utilization is the joint use of satellites by many countries. These various countries are allotted capacity in the satellites. If the traffic requirements of non-U.S. users are low, the circuits allotted to non-U.S. entities may be largely unused thereby reducing capacity utilization of a satellite.

The circuits allotted to Comsat may be intensively utilized but U.S. use could be offset by limited use of circuits available for non-U.S. traffic. However, in the time period under observation the U.S. was the dominant user of satellite facilities in conjunction with European countries. Only recently has U.S. use decreased relative to non-U.S. use due to an increase in the number of foreign earth stations communicating with Atlantic Basin satellites.

As previously mentioned, the indices are most meaningful when capacity is utilized at approximately the same high level for different vintages of capital. In the event that capacities are used at a low level, the percentage of capacity utilization should be approximately equivalent. If neither case exists the results become difficult to interpret. If high and low utilization of capacity exist simultaneously on the facilities used, productivity differences may not be evident.

Related to capacity and usage differentials is a problem that is peculiar to satellites. The capacity of cables can be fully used if demand is sufficient, i.e., all circuits can be used and circuits can be added on an individual basis until capacity is saturated. The same does not hold for satellites. There is a difference between design capacity and usable capacity. The latter capacity is less than the former and it varies depending on the carrier configuration and loading of circuits.

The capacity of the carriers from the earth stations to the satellites is in various sized blocks of channels, e.g., 24, 60, 132, and 252. If circuits are needed from the U.S. to a foreign earth station they must be added in one of these blocks and cannot be added one at a time as on cables. For instance, if one or two circuits are needed to Spain, the minimum sized carrier to satisfy this requirement is 24 channels. The remaining channels will be idle in the absence of sufficient demand because they cannot be used to meet requirements to another country. As a result, usable satellite capacity is reduced and the amount of the reduction depends on the configuration and loading of the carriers. Furthermore, the capacity of a satellite can vary depending on configuration. For example, the configured capacity of Intelsat III-F-7 is expected to vary between 1680 and 2280 half circuits over the 1970-1972 period, but the design capacity is 3,000 channels plus TV.[7] A determination of capacity is, therefore, difficult and, by implication, the utilization of capacity.

The problem of satellite capacity is compounded by a difficulty in defining output for the accounting cost measure. Generally, a voice-grade circuit is the standard unit. For normal commercial traffic the circuit will serve as a unit of capacity. However, NASA traffic

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[7]Comsat Comments, op. cit., p. C-24.

is different. Under normal conditions a unit of utilization on a satellite is equivalent to a half circuit, i.e., the link from an earth station up to the satellite. NASA circuits require more power because the earth station antennas are substandard, i.e., smaller in diameter. Greater power is required to meet quality of service standards. As a result, the equivalence between a unit of utilization and a half circuit does not hold. Capacity utilization, therefore, differs when these non-standard NASA circuits are transmitted over a satellite. The percentage of capacity used is greater when measured in units of utilization than when measured in circuits on satellites handling NASA traffic.

Finally, there are the ownership peculiarities of satellites and cables. Since cables are owned partly by common carriers and partly by their foreign correspondents and ownership of the satellite system is widely dispersed, a question of the relevant costs arises. Should the portion owned by U.S. interests compose the portion to be analyzed or should the total (U.S. and foreign) cable and satellite costs be included? The answer to this question depends largely on the purpose of the analysis, and, of course, affects the final calculations.

Basis of the Measures

The conceptual problems in comparing cables and satellites that stem from the differences in the communications mediums enhance the difficulty of applying conventional economic analysis. A resolution to these problems is presented after discussing each one in turn in light of the issues being addressed.

The first area of concern is the difference between point-to-point and multi-point communication. This problem exists primarily in making alternative investment comparisons. In attempting to evaluate alternative facilities in light of projected traffic requirements satellites are generally treated as if they are a point-to-point communication mode.[8] The emphasis is on determining the least cost alternative as part of a long run planning decision. Expectations and assumptions as to demand growth are, therefore, crucial.

The present analysis is fundamentally different from a least cost evaluation of investment proposals. The relevant time frame is not the future but the past. Thus, the immediate concern is not one of choosing the least cost alternative, but of analyzing decisions that have already been made and have resulted in a given mix of

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[8]Examples of this type of comparison include Andrew J. Lipinski, "On the Mix of Satellites and Cables in the Global Network," IEEE Transactions on Communication Technology, Volume Com-15, No. 2; Rodney D. Chipp and Thomas Cosgrove, "Economic Considerations for Communication Systems," IEEE Transactions on Communication Technology, Volume Com-16, No. 4; A. D. MacKay, B. M. Dawidziuk, H. F. Preston, "Economic, Operational, and Technical Aspects of Modern Global Communication Systems," Electrical Communication, Volume 43, No. 1.

facilities. The interest is with the use of installed facilities, the impact of different vintages of equipment in meeting traffic requirements, and the effect on communication costs resulting from the mix of facilities and the policies being followed. Thus, the focus is not on long run planning decisions but the impact on short run operations resulting from previously made decisions that determine the mix of equipment. It is not necessary to artificially constrain satellites to point-to-point communication. Presumably, investment decisions properly evaluated the need for facilities to satisfy projected requirements among various points. The focus is an analysis of the installed facilities as they are used and the changing mix as expansion occurs. In examining the facilities as part of the communication network the difference between point-to-point and multi-point is immaterial. At issue is the impact on the integrated network in meeting traffic requirements, point-to-point and multi-point communication is not an issue.

The difficulty in determining the number of earth stations to include in the satellite system is largely reconciled by the issue being considered and the time perspective. The purpose of the analysis is not to determine the least cost investment alternative nor the optimal number of earth stations. The analysis focuses on the installed facilities operating with the orbiting satellites. As a result, logic dictates that all earth stations operating with a given satellite be included. If all earth stations are not included in the analysis of a satellite configuration, the satellite would not have operated at the same circuit level. Further, arbitrarily excluding certain earth stations or including only two earth stations misrepresents the actual situation and may result in erroneous conclusions. The perspective is historical and, therefore, the actual satellite-earth station configurations are appropriate.

The third difficulty of different expected lives for cables and satellites is similar to the point-to-point and multi-point question. The expected life of a facility is relevant when comparing investment alternatives. Once the facilities are installed the relevant question is the effect of the investment decisions on providing communication services at low operating costs. It is not necessary to determine the cost of facilities with comparable lives but the cost of services provided in a given year. The relevant period of analysis is the short run and not a planning decision as in the case of assessing investment alternatives.[9] Thus, comparability of life is not an

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[9]The expected life of cables and satellites does affect their annual costs through the depreciation expense. Presumably, the depreciation policies are evaluated by the companies as part of the investment decision and reflect their forecasts of capital consumption.

issue with annual unit accounting costs or the output-input index.

The issue of institutional ownership should have no bearing on determining the cost of the two systems. The ownership peculiarities do make cost estimates more difficult to derive because of the division of costs between U.S. firms and their foreign counterparts. For example, AT&T must estimate the foreign investment cost of cables based on the ownership percentages because the amount spent by its foreign correspondents is not known.[10] A similar situation exists with foreign earth station investment costs. Comsat, along with the common carriers, are responsible for the installation of only U.S. earth stations. Foreign earth stations are constructed under the auspices of the responsible foreign authority. These earth station costs must be based on estimates due to the inaccessibility of actual data. The assumption is made that these estimates are reasonably accurate because the amounts used are the contract prices.

Since entire systems, i.e., a whole cable and satellite configuration, are being studied, it is concluded that the relevant facilities should not be distinguished by ownership interests. The institutional

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[10]This problem was emphasized in two letters, dated February 17, 1970 and July 31, 1970, from H. H. Joyner of AT&T to author.

peculiarities are ignored. If the issue was to determine revenue requirements then the ownership interests would be relevant. In this case, the owned capital would be a determining factor. In the present analysis the ownership of the capital base is not important.

The problem with defining satellite output is resolved by the need to compare unit costs of satellites and cables in equivalent terms. Units of utilization that are substandard (the NASA circuits) are small in number and are not significant in the overall loading of satellite capacity. Therefore, capacity and use of capacity will be in terms of voice-grade circuits and NASA services will be included as equivalent circuits, not as the number of units of utilization from which revenue is derived.

Satellite capacity poses a problem because there is no way to determine an unquestioned number of circuits as capacity. Capacity varies with satellite usage, i.e., for high density traffic or global coverage, and how the carriers are configured and used. However, based on previous experience a reasonable rule of thumb appears to be that about 75 percent of design capacity can be considered as workable, configured capacity. This figure is used for all satellites except the Intelsat I which had a larger workable capacity because it was dedicated to high density routes and rotated among the European earth stations on a periodic basis.

The difference in usage of cables and satellites poses a real problem. Little can be done to overcome use differentials that may exist. This problem is significant primarily in regard to the output-input index. The period of time under consideration is so short that it is not possible to analyze only those years when facilities are used at equal and high levels of capacity. The only recourse available is to use each year of operation, to examine each facility in operation during the year, to indicate that the results are the effect of various interacting factors, and to emphasize the impossibility of isolating any one factor. However, years may exist when some facilities are used at high levels and in these years more definite statements are possible.

The basis for analyzing the operation of the transatlantic communication network can be summarized. Individual satellite and cable facilities are analyzed on the basis of annual unit costs and productivity as reflected by an output-input index. Total utilization of each facility in each year for unit accounting costs, irrespective of the number of communicating points, is measured by the year end circuits in service. Revenue totals measure utilization for the output-input index. All relevant earth stations are included in the satellite analysis. Transit charges to countries not having direct communication links are not included in the cost analysis. Both measures are used to compare individual facilities and to indicate possible trends that may be caused by increased utilization and the introduction of advanced techniques. The purpose of employing these two measures is to get a fix on the operation of the transatlantic network in light of the implications of market structure and investment policies.

Empirical Findings for the Transatlantic Network: 1965-1970

This section on the empirical results consists of two subsections. In the first subsection the estimates of the unit accounting cost measure are presented and described. The output-input calculations are discussed in the second subsection.

Unit Accounting Cost Results

The annual accounting costs per circuit, in service, for each of the six years observed are shown in Figure 1. The cost data and the figures for activated circuits are discussed in detail in Appendix A. As explained in that appendix, a range of unit costs is derived for each facility. The results presented in Figure 1 represent the lower estimated unit cost figures.

Several observations and comments can be made about the annual unit costs. With the exception of TAT-4, the annual unit costs for each cable are constant for each year observed. TAT-4, on the other hand, exhibits an

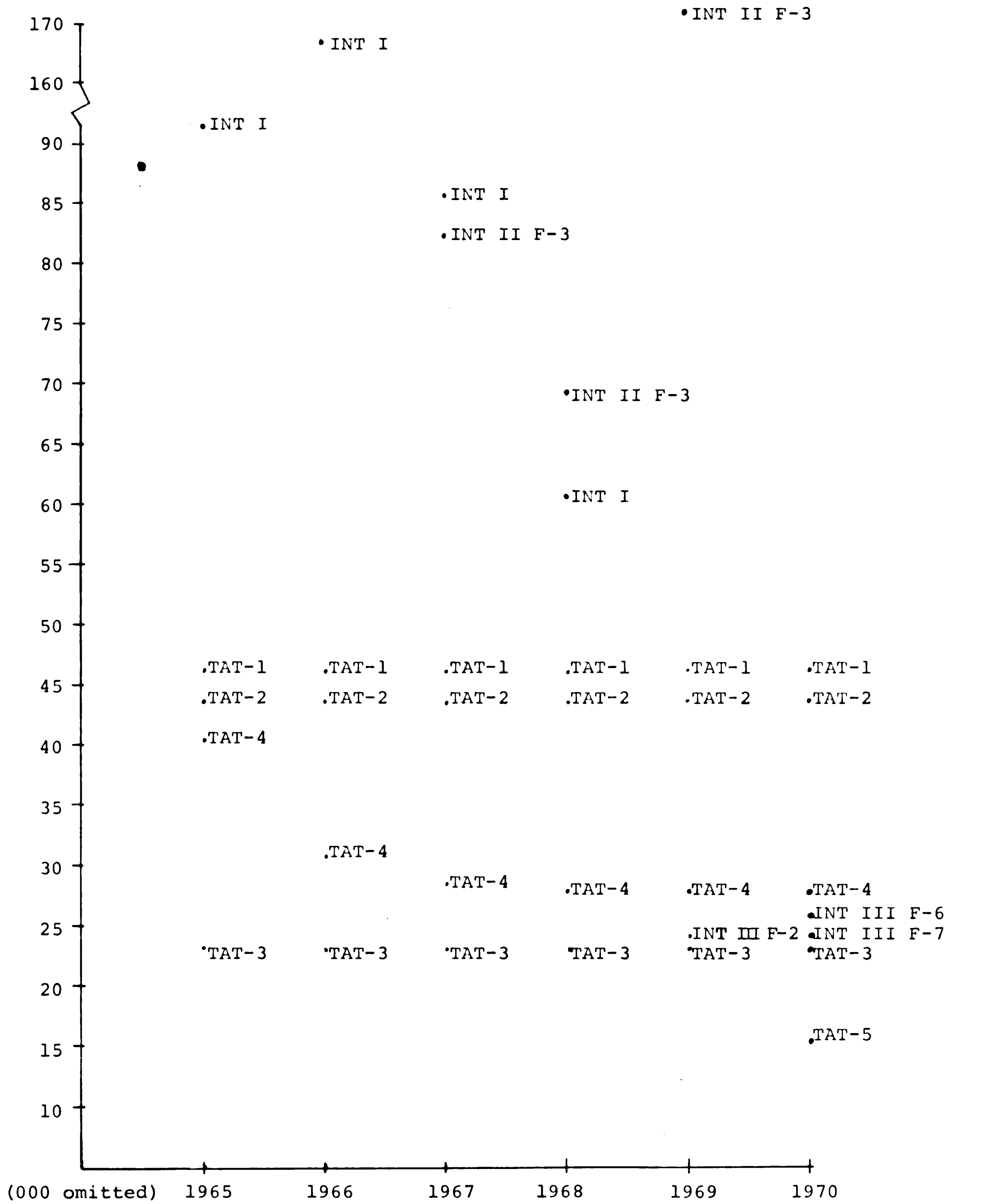

FIGURE 1--Annual Cost per Circuit in Service 1965-1970.

initial decline in unit accounting costs that tends to level off in the latter years. This decline is based on an assumption pertaining to fill factors of the cables that seems to be reasonable. TAT-4 commenced operation in 1965 to meet increases in traffic requirements that could not be satisfied by the existing three cables because each one was fully utilized, i.e., all circuits were necessary to meet the peak traffic demands. The addition of TAT-4 resulted in a surplus of circuits that were not activated initially. In order to estimate the unit cost of circuits in service it is necessary to determine the location of the spare circuits. AT&T could not provide the necessary information on an annual basis.[11] Since the TAT-4 cable was installed to meet growing traffic requirements the assumption was made that the spare circuits were on TAT-4. As a consequence, the first three TAT cables were operated at the capacity level for all years observed and any additional cable requirements were met by an increase in the active circuits on TAT-4. Therefore, the unit costs of TAT-4 circuits fall until capacity is reached in 1968. By 1968 all circuits on existing cables were in operation.

The assumption relating to the exact location of the spare cable circuits may not be entirely accurate.

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[11]Information of this type was supplied to the FCC on circuit usage for October 1, 1967, in "Response of AT&T to Letter of the FCC," dated October 4, 1967. AT&T supplied the author with similar information for September 18, 1969.

The difficulty in determining the allocation of spare cable circuits is twofold. One problem concerns the ability to switch circuits from the U.S. to foreign destinations among cables at any time. To illustrate, in 1967 a portion of the traffic to Norway and Finland was carried on TAT-1. By 1969 this traffic had been switched to other cables. To the extent that switching actually occurred, spare circuits may have existed on any or all the cables until 1968. However, with the exception of 1965, the total number of spare circuits in any year was not great and progressively decreased to zero in 1968. The second problem is that monthly circuit analyses of AT&T are presented in terms of total circuits to various countries and are not broken down by individual facilities.[12] In consequence, active circuits cannot be traced from these records.

The point should be emphasized that the inability to pinpoint the idle circuits does not detract from the unit cost estimates. The number of spare circuits is small. Furthermore, the effect of spreading the idle circuits among the four cables is predictable. Annual costs per circuit of TAT's 1-3 would increase slightly over the given estimates. Conversely, unit costs of the TAT-4 would

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[12]"Overseas and International Telephone Service, Countries or Areas Reached and Number of Message Circuits," Report by AT&T Long Lines Department, Office of Traffic Operating Engineer, 1965-1969.

be somewhat lower. The overall effect on unit costs will not be substantial because of the relatively small number of idle circuits.

The annual cable cost figures represented in Figure 1 demonstrate several salient points about transmission costs in international communication. There has been a rather significant reduction in the annual costs of cable circuits. The second generation of cables, TAT-3 and TAT-4, embodied technological advances along with an increase in capacity. The result of the two effects appears to have continued with the introduction of TAT-5. Although the O and M expenses of TAT-5 are not based on operating experience of this cable, the trend toward lower annual costs per circuit appears to continue. It should also be noted that the lower level of annual unit costs of TAT-5 in 1970 was achieved while operating at less than 50 percent of capacity.

A second feature worth noting is the trend toward lower annual costs per circuit with TAT-4 as its load factor increased over the period observed. The falling unit costs are the result of spreading overhead costs over an increasing number of circuits in service and the gradual exhaustion of indivisibilities in the transmission plant. If this characteristic is a general trait of cables, the annual unit costs of TAT-5 can be expected to fall below the level indicated in Figure 1 as more circuits are activated in future years.

One final point deserves notice before passing on to a discussion of satellite costs. The reduction in annual unit costs of TAT-4 circuits indicates that the lowest costs are achieved by operating this cable at its capacity level. It would appear that, for an individual cable, annual unit costs can be minimized if all circuits are in service. In spite of the significant difference in the level of annual circuit costs, the results of the observed period indicate that, individually, the cables were operated efficiently.

As demonstrated in Figure 1, the annual unit costs of the various satellites and their associated earth stations do not seem to follow the same systematic pattern of cables. In some years annual satellite circuit costs were very high and in other years these circuit costs were low. Those years in which the annual unit costs were very high can be partly explained by circumstances.

Figure 1 indicates a very high level of circuit costs for Intelsat I and Intelsat II-F-3. This high level is the consequence of a combination of high annual costs for satellites and earth stations and low utilization of this initial application of satellites to commercial communication. The fill factor of these two satellites was particularly low in certain years. In addition, there is a significant rise in the unit costs of Intelsat I in 1966 relative to 1965, in spite of increased utilization. The rise is more apparent than real and can be explained by the fact that Intelsat I was operational for only half of 1965. As a result, depreciation and O and M expenses essentially double with a full year of operation and outweigh the increase in utilization of satellite circuits in 1966. In essence, 1965 is an atypical representation of annual satellite costs. Thereafter, utilization continued to increase and total annual costs stabilized resulting in a fall in unit costs as they were spread over a growing number of circuits in service.

The extremely high level of Intelsat II-F-3 unit costs in 1969 is primarily due to the transfer of most satellite traffic to the Intelsat III-F-2 in this year. Intelsat II-F-3 handled only NASCOM (NASA communications) traffic and a small number of U.S.-U.K. circuits at the end of the year.

Finally, Intelsat III-F-2 appears only in 1969 on Figure 1. This satellite was removed from operational status in early 1970 due to a mechanical failure of its antenna. This problem was a recurrence of a similar difficulty that caused its withdrawal from service for the month of July in 1969.

The general direction of annual circuit costs of satellites is similar to that of cables although the trend is not as evident. The advances in technique and the significant increase in capacity associated with the Intelsat III generation of satellites have resulted in a substantial reduction in the level of unit costs. The high level of annual unit costs associated with the first two satellite generations appears to have been overcome with the Intelsat III generation. The growing usage of satellite circuits with the higher capacity Intelsat III's resulted in a level of unit costs comparable with TAT-3 and TAT-4 while surpassing TAT-1 and TAT-2. However, the annual satellite circuit costs are still substantially in excess of TAT-5.

The trend of unit accounting costs of satellite systems appears to be in a downward direction and is significantly influenced by the number of circuits in service. The dramatic rise in unit costs of Intelsat II-F-3 illustrates the impact of a low level of utilization. Conversely, the low costs associated with each Intelsat III demonstrate the benefits of reducing excess capacity. This reduction in unit costs is the net effect of two offsetting factors. On the one hand, unit costs are reduced by utilizing capacity at a high level. On the other hand, the number of earth stations expanded as foreign countries began to install terminals. The increase in earth stations produced a rise in total annual costs of the satellite systems but also resulted in an increase in circuit utilization. The net effect has been a reduction in annual unit costs as the satellite systems have expanded.

The general picture of the transatlantic communication network for the 1965-1970 period is one of variability. A number of additions to capacity have been made. As a result of increases in scale and advances in technique, the general direction of annual unit costs has been downward. However, the simultaneous use of different vintages of capital has resulted in a wide variation of annual unit costs among individual facilities. This variation is a characteristic of all the years observed and, although the variation tended to narrow in more recent years, it continues to be significant. The installation of TAT-5 and the recent launch of Intelsat IV-F-2 may prolong the existing discrepancy in annual unit costs. The implications of the existing pattern of annual costs per circuit in light of the market structure require attention and will be discussed at a later point.

Output-Input Index Results

The output-input ratios are presented in Table 1. The results do not include 1970 because output data is not yet available from the carriers. It should be noted that the indexes have been calculated for both net and gross output. The primary difference between the gross and net measures is the exclusion of annual depreciation from the latter. The deduction of depreciation from output makes output correspond more closely to net value added and is included to see if this implicit allowance for differential life spans has any effect on the relative indexes. An examination of the results indicates that there is no relative change when depreciation is taken into account.

TABLE 1.--Output-capital ratios for individual facilities, 1966-1969.

Facility	Gross Output				Net Output			
	1966	1967	1968	1969	1966	1967	1968	1969
TAT-1 & TASI-1	2.7	2.8	2.7	2.8	2.4	2.5	2.3	2.5
TAT-2 & TASI-2	2.7	2.8	2.7	2.5	2.4	2.5	2.4	2.2
TAT-3 & TASI-3	5.4	5.6	5.0	5.0	5.2	5.4	4.8	4.8
TAT-4	4.8	5.8	5.2	5.2	4.6	5.6	5.0	5.0
Intelsat I	1.6	1.7	3.2		0.8	0.9	2.4	
Intelsat II-F-3		1.7	3.2			0.8	2.5	
Intelsat III-F-2				8.3				7.6

The results of the output-capital ratios must be carefully interpreted. A change in the value of an index from one year to the next may be caused by a number of factors. The indexes may be influenced by more intensive utilization of a facility, economies of scale, or technological change, to specify the more obvious variables. A characteristic of the facilities used in international communications is the coincidence of technological advance and larger capacity with new facilities. Also, the passage of time brings more intensive utilization as demand grows. As a result, the factors influencing the value of the index tend to be interrelated.

In comparing the results of the output-capital ratios explicit recognition must be given to differences in the utilization of capacity. If individual facilities are operating under different fill factors, any conclusions drawn from a comparison of the indexes must take the fill factor into account. With significant indivisibilities of capital, the relative advantage of one facility may be caused by more intensive utilization. To conclude that the productive efficiency of the one is greater than the other under such circumstances could be erroneous. Capacity utilization of the cable and satellite facilities is therefore presented in Table 2 in order to point out these differences.

With these caveats in mind, the results can be examined. The most prominent feature about the cable indexes is the differential between the first generation (TAT-1 and TAT-2) and the second generation (TAT-3 and

TABLE 2.--Capacity utilization of individual facilities 1965-1970 (expressed as percentages).

Facility	1965	1966	1967	1968	1969	1970
TAT-1 & TASI-1	100	100	100	100	100	100
TAT-2 & TASI-2	100	100	100	100	100	100
TAT-3 & TASI-3	100	100	100	100	100	100
TAT-4	67	89	97	100	100	100
TAT-5						35
Intelsat I	34	39	68	92		
Intelsat II-F-3			40	85	22	
Intelsat III-F-2					79	
Intelsat III-F-6						64
Intelsat III-F-7						42

Note:

Percentages for satellites are based on estimates of usable capacity, not design capacity. For design capacity, percentages would be lower but less meaningful.

TAT-4). The high level of utilization in all years tends to indicate that the technological advances incorporated in TAT-3 and TAT-4, along with the increase in capacity, resulted in an increase in productivity. The relative influence of each factor cannot be determined but the conclusion is clear--the productivity of TAT-3 and TAT-4 increased relative to TAT-1 and TAT-2.

The impact of utilization can be illustrated with the TAT-4 cable. As usage of this cable expanded the output-capital ratio increased. With technology and scale constant, the most reasonable explanation for the increase would appear to be a rise in the utilization of capacity.

The results of the various satellites are more difficult to assess primarily because of the variability in circuit utilization of the satellites. For the observed satellites, utilization of capacity varies from a low of 22 percent to a high of 92 percent. In spite of the varying levels of utilization some observations can be advanced. For each satellite and its associated earth stations, productivity increases with the level of utilization. Both Intelsat I and Intelsat II-F-3 display a significant rise in the output-capital ratio as capacity utilization increases. As with the TAT-4 cable, technology and scale remain constant so variation in use seems to be the main variable affecting the index. A similar observation cannot be advanced for Intelsat III-F-2 because this satellite was in operation for only one year.

An interesting phenomenon should be noted in connection with Intelsat I and Intelsat II-F-3. In 1967 and 1968 these two satellites were operated at different levels of capacity and, yet, the values of the indexes are similar. The capacities of the two satellites were the same, 240 circuits, although Intelsat I was a point-to-point satellite and Intelsat II-F-3 was a multi-point satellite. One is tempted to infer that Intelsat I is less productive than Intelsat II-F-3 because the indexes are essentially the same but the former satellite was more intensively operated. However, a difference exists in the number of earth stations associated with the satellites. This difference may be sufficient to explain the equality of the indices. However, the equality may also be the result of differences in the sophistication of the technology. In short, no definitive conclusion can be drawn.

In the case of Intelsat III-F-2 a similar problem does not arise. With this satellite a significant difference of its index relative to the previous two satellites is evident. The Intelsat III-F-2 also operated with more earth stations than the other two. Further, the level of capacity utilization of Intelsat III-F-2 was lower than the other two. These factors tend to imply that Intelsat III-F-2 represents a significant increase in the productive efficiency of this generation of satellites relative to its precursors. Further, the indivisibilities have not been completely exhausted at the 1969 level of utilization. The implication can be advanced that expanded usage would serve only to increase the output-capital ratio.

In light of these considerations, it does not seem unreasonable to conclude that Intelsat III-F-2 represents a significant increase in satellite productivity relative to its predecessors. Whether the increase can be attributed to an improvement in the technology, an expansion of scale, a combination of the two factors, or other factors cannot be ascertained from the results. However, it does seem evident that the satellite technology is experiencing gains in productivity as new generations are introduced.

The results obtained from the application of output-input type measures tend to concur with the findings of the unit accounting cost measures. It was noted that unit accounting costs of individual facilities exhibited a general tendency to fall with the introduction of advanced and larger capacity equipment. The output-input indexes reveal a similar tendency with respect to productivity, i.e., it is rising with new facilities. As a result of rising productivity, the disparity between new facilities and existing facilities tends to become more pronounced. In 1969, for example, the relative variation in the output-capital ratios was greater than in any other year, ranging from 2.5 to 8.3. The significant and increasing disparity among facilities indicated by the unit accounting cost measure and the output-capital ratio give rise to a number of interesting structure-conduct implications that will now be discussed.

Empirical Results and Depreciation

The continued existence of a wide variation in the estimates of annual unit accounting costs and the output-input ratios among individual facilities may be partially explained by the depreciation of cables and the existing market structure. While the high cost satellites have been replaced, the older cables, TAT-1 and TAT-2, continue in operation despite their higher costs and lower output-input indexes. Their contribution to capacity is small relative to the more advanced cables and satellites, but the annual cost of these cables is significantly greater than the level of TAT-3 and TAT-4 and the order of magnitude is increasing as newer facilities are introduced. However, every indication leads one to conclude that these facilities will continue in service until their expected lives have expired.[13] As more advanced facilities are introduced the relative burden of TAT-1 and TAT-2 on achieving lower unit costs for the communication network will increase. Illustrative of this probability is the progressively widening disparity between the annual unit costs of TAT-1 and TAT-2 and all other facilities in 1969 and 1970 in Figure 1. In the early years of the observed period these two cables compared favorably with Intelsat I and Intelsat II-F-3. As these satellites were phased out of service and replaced, the situation changed. If the trend in unit costs continues, the position of TAT-1 and TAT-2 vis-a-vis other facilities will continue to

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[13] Joyner, op. cit., p. 2.

deteriorate.[14] In all likelihood, a similar pattern can be anticipated for TAT-3 and TAT-4.

The impact on the communication network of a long depreciation period in the face of rapid technological advance becomes apparent. The annual cost of operating such facilities becomes rather excessive relative to the alternatives and its productivity suffers in comparison to other facilities. An understatement of depreciation caused by an underestimate of the obsolescence factor or an overestimate of service life (and perhaps both) has resulted in the use of a potentially obsolete facility. The annual depreciation expense per circuit ranges from a high of $25,600 for TAT-1 to $4,400 for TAT-5.

The fill factors of individual facilities take on added importance with the variation in annual costs. The level of annual costs may be explained in part by the number of circuits in service on a cable or satellite. Continued use of TAT-1 and TAT-2, and at a high level of capacity, appears to have a noticeable effect on maintaining annual unit costs of other facilities at high levels. An indication of the impact on annual unit costs of operating at a low level of capacity is illustrated by comparing Intelsat II-F-3 in 1968 and 1969. Even more noticeable is

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[14]The figures presented by Comsat in their filing in Docket Number 18875 (p. 12) indicate that satellite circuit costs for Intelsat IV will be lower than the previous generations.

the differential between the capacity costs of Intelsat II-F-3 and the costs associated with its actual utilization level in 1969. With actual utilization at 22 percent, unit costs are substantially greater than the level of capacity costs.[15] There is also a noticeable gap between the unit costs of TAT-1 and TAT-2 vis-a-vis Intelsat III-F-6-7 and TAT-5 when examining capacity costs in 1970. Part of the burden of continued use of TAT-1 and TAT-2 is camouflaged because these two cables are operated at capacity while alternative, lower cost facilities stand by with idle capacity. The result is to inflate annual unit costs of the circuits in use through restricted utilization while the costs of TAT-1 and TAT-2 are at their lowest possible level due to maximum usage.

The variation in annual costs among facilities and the tendency toward a continual widening of the differentials focuses attention on a general problem involving the interplay of many factors. A primary impediment to the introduction and diffusion of equipment embodying the most advanced techniques is the presence of old capital stock. The existing facilities in international communication compete with the most advanced capital. The depreciation policy, in particular the provision for obsolescence, plays a vital role in the adoption of new

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[15]The estimated annual cost per circuit at capacity in 1969 is approximately $60,000, based on the cost estimates derived herein.

equipment. In principle, a firm should replace an individual facility when its operating cost is greater than the total cost of an alternative. However, the allowance for depreciation directly affects the level of the operating costs. Choosing a conservative, long period, straight line policy minimizes the annual depreciation expense and, as a result, operating costs. In this way, the firm can predetermine its replacement policy through the arbitrary selection of depreciation.

Market structure may act as a further deterrent to replacement. In a perfectly competitive industry subject to changing technology new plants reflect the latest technology. When price exceeds their average total costs the new plants will be built. Downward pressure is exerted on the price and the oldest plants are scrapped when operating costs cannot be covered. The market structure in the international communications industry is characterized by AT&T's monopoly in voice communications. Comsat, in its subordinate role, is foreclosed from actively offering a competitive alternative. With AT&T controlling the market, the spur provided by competitive pressure is effectively blunted and a unrealistic depreciation policy is insulated. The existing, high cost facilities remain in the rate base, safe from unanticipated upheaval and the status quo is maintained. New developments in technology do not result in replacement but addition to the existing capital stock.

The size and structure of the existing capital stock is characterized by numerous vintages of equipment with different levels of productivity. The advances in productivity are thereby diluted by continued reliance on old capital.

There is a further inducement to retain capital and depreciate facilities over a long period of time. Rate of return regulation provides an incentive to maintain a high capital base for an extended period in order to maximize the absolute level of earnings consistent with the fair rate of return. One means of achieving this objective is to employ a long-term, straight line depreciation policy. In sum, a positive inducement exists for AT&T to follow the present depreciation policy and there are no compelling market forces operating to insure correction in the event of decision errors.

Operation of the Network and Composite Pricing

The variation in the level of annual unit costs and output-input ratios appears to have no significant impact on determining the operation of the total network. All facilities are used simultaneously irrespective of the effect of utilization on annual circuit costs. There does not appear to be any conscious effort to operate the lowest cost facilities to their maximum. Older cables subject to high unit costs are operated at capacity while lower cost facilities stand by with idle capacity. This occurrence is particularly evident in the latter portion of the period observed. Large capacity facilities were installed and large numbers of circuits stood idle. Meanwhile, the low capacity, high cost facilities were operated essentially at capacity. In 1969 all four cables operated under conditions of total circuit activation. At the same time Intelsat III-F-2 was operating at 79 percent of capacity and Intelsat II-F-3 was at 22 percent. Even more illustrative are the figures for 1970. In that year the lower cost facilities were uniformly operated below capacity and, in the case of Intelsat III-F-7 and TAT-5 the number of inactive circuits was substantial. Thus, rather than operating the more technologically advanced facilities intensively in order to take advantage of the apparent economies of utilization, the opposite seems to be the case. Economies go unrealized and the potential benefits of newer facilities are diluted by the overall operation of the network. This phenomenon is particularly evident with the more recent, large capacity facilities but it can be expected to continue for all additions to capacity if the older facilities remain in service beyond their economic life.

The prevailing pricing policy employed by AT&T does not give rise to incentives that will alter current operation. On the contrary, there is every incentive to prolong this conduct. Prices are established on a composite basis. This policy goes one step further than the nationwide averaging employed by AT&T for the domestic communication network. The rates paid by AT&T for leasing satellite circuits are averaged in with the cable costs in determining rates and are thereby a portion of the composite rates paid by the user. In effect, all vintages of capital are averaged together and AT&T sets rates as if it owned all the facilities.

The impact of this averaging can be appreciated to some degree by looking at a recent set of annual revenue requirements for cable half circuits submitted by AT&T in its TAT-6 application:[16]

TAT-1-5	$22,000 per half circuit per year
TAT-1-6	$16,600 per half circuit per year
TAT-6	$ 8,600 per half circuit per year

For TAT-2 alone the comparable figure is $52,000. These figures do not include satellite circuits and, therefore, indicate only the magnitude of the impact in averaging different vintages of cable capital.

This type of average pricing employed by AT&T implies that the more advanced facilities, with lower costs, serve to subsidize older facilities. It is clear that current costs are markedly lower than embedded costs. Further, the significant differential in unit costs suggest

[16]Application of AT&T for TAT-6, August 28, 1970.

that the obsolescence factor in depreciation allowances has been seriously understated. In order to make the older facilities remunerative, in light of an improper timing of annual depreciation, rates are established on the basis of an average technology. As a result, rates tend to be higher than in the absence of older equipment and demand is restricted.

The composite pricing policy and the existing market structure tend to work together as cooperating forces that hinder the realization of potential benefits. If there are inherent benefits in satellite communication, either due to its scale or its multi-point capability, average pricing tends to neutralize their impact on rates. Satellite facilities are averaged in with all other facilities and will tend to be higher than if based separately on satellite costs.

Further, the composite rates tend to impede the incentive to reflect any pervasive economies of scale in satellites or cables in rates. The rates are established to cover the cost of the total network. The need to insure the economic viability of higher cost facilities affects the level at which rates can be set. With older facilities in the capital base, it may not be possible to establish a rate structure with rates at a sufficiently low level to encourage realization of the economies.

The monopoly in international voice communication enjoyed by AT&T removes the threat of competitive entry. No firm exists with the capability to serve the market with lower cost facilities, and thereby disrupt the averaging process. Comsat is essentially precluded from going to the final market and, therefore, offers no threat to AT&T. Regardless of the level of Comsat's rates, the averaging process ensures a return on all cable equipment. In addition, there is no incentive for AT&T to alter its pricing policy. Indeed, there is a positive dis-incentive because AT&T's rate of return is based on its capital base. In short, AT&T is free from the stimulus of market pressure and the averaging process strengthens its latitude in setting prices.

Pricing Practices of Comsat and Empirical Findings

The failure of the common carriers to lease satellite circuits in sufficient quantity to ensure a high level of satellite utilization may be partially explained by Comsat's pricing policy. The carriers, of course, have a preference for cable circuits due to ownership interests. However, the pricing practices of Comsat may not provide sufficient incentives to lease satellite circuits in the absence of outside pressures such as the proportionate fill policy. Further, Comsat may be in a position to take advantage of its satellite monopoly and Commission rulings concerning the leasing of satellite circuits.

The rate structure of Comsat should be explored in relation to its market position and, particularly, in light of the empirical findings for satellite communication. The measures applied to satellite communication are in substantial agreement. The accounting cost estimates show a substantial reduction in satellite unit costs. The output-input index indicates that substantial gains have been made in advancing the productivity of satellite capital. In light of these findings, Comsat's basic rates, with one exception, remained unchanged during the period analyzed, 1965-1970.[17] The sole exception was a reduction of approximately 40 percent in television rates in February, 1969. The justification for this reduction was the activation of a larger capacity satellite, Intelsat III, that did not necessitate interruptions of other services for television service, as was the case with the previous satellites. The rates for its basic service, full-time leased circuits to the carriers, were unchanged throughout the period. For

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[17] Comsat instituted a 25 percent rate reduction on July 1, 1971 for routes between the U.S. mainland and Europe, the Middle East, Africa, and South America and Puerto Rico to Europe. This action reduced the annual charge per half-circuit from $45,600 to $34,200. It is interesting to note that in proposing this rate reduction, Comsat listed four conditions to the Commission before the reduction could be instituted and one condition was the denial of the TAT-6 application.

example, the monthly rate for a half circuit to Europe, South America and Africa remained at $3,800.

In light of the substantial gains in productivity it would appear that some alteration in the lease rate of satellite circuits should have been instituted by Comsat. The opportunity exists to engage in various types of incentive pricing and innovative services is an attempt to stimulate the demand for satellite circuits, perhaps to developing countries. At the very least, these productivity gains should, in part, have been passed on to the user of the communication facilities in the form of some reduction in rates.

The failure of Comsat to undertake any significant adjustments in rates during this period may be a reflection of its market position that is reinforced by specific Commission rulings. Comsat was created as, and remains, the sole U.S. supplier of satellite circuits to the international common carriers. The firm faces no competitive threat in this venture. However, Comsat cannot actively compete with the common carriers in the final market because its carriers' carrier status generally prohibits direct access to markets. This exclusion may thwart any incentive to reduce rates. On the other hand, the carriers are compelled to go to Comsat for satellite circuits because there is no alternative. Further, with the proportionate fill policy Comsat is virtually guaranteed a substantial segment of the market regardless of the rates it sets. The authorization of additional facilities in response to growing traffic requirements will also determine Comsat's portion of the market as more and more satellite circuits are added relative to cable circuits.

Comsat is certainly in a position to exploit the gains in satellite technology. Faced with the virtually captive market of the international carriers, Comsat appears to be exploiting this potential. In light of Comsat's almost constant assertions about the pervasive scale economies of satellites and the productivity gains, its pricing practices strongly suggest that the benefits have been internalized by Comsat rather than being passed on and realized in the form of reduced rates.

Concluding Comments

It is not obvious from the analysis of unit costs and output-input indexes that one technology is clearly superior to the other in terms of costs or productivity. The advantages of different facilities, individually and in combination to form the total network, vary with time, utilization, growth in requirements, and the incorporation of technological advances in additions to capacity. The effort to achieve system optimization will, therefore, depend on the mix of facilities over time rather than sole reliance on one technology to satisfy all communication requirements. The addition of low cost facilities, properly timed, has a positive effect on the adaptation of the communication network to advances in technology for meeting traffic requirements.

Once investments have been made the relevant consideration becomes the operation of existing facilities in a manner that maximizes the benefits of the users. To the extent that system optimization is based on minimizing costs, the operation of the communication network, given the mix of facilities, appears to be suboptimal. There is continued reliance on facilities that are, at best, high cost but possibly obsolete in light of the dynamics of communication technology. The older facilities are operated at a high level of capacity while modern plant operates simultaneously with excess capacity. This type of behavior serves to partially negate the potential benefits emanating from technological change and intensive utilization of those facilities most susceptible to increasing returns to scale.

Unfortunately, the prevailing market structure and rate of return regulation do not provide the necessary stimulants to correct the existing situation. There is an incentive to retain all equipment in the rate base and there is no penalty in the use of a depreciation policy that is inappropriate under existing conditions. Further, there is a total absence of effective competitive pressures that will force the firms to make correct investment decisions and operate the system in an efficient manner. The impact of public policy remains as a potential means of correcting these shortcomings in an effort to promote system optimizing conduct.

CHAPTER V

PUBLIC POLICY ISSUES AND INFORMATION REQUIREMENTS

Two basic issues emerge from the foregoing analysis of industry structure, investment behavior, and the empirical results of the transatlantic communications network. One issue is the quality of information currently available and used in formulating regulatory decisions and policies. The other issue is the broader public policy question of whether the industry structure yields adequate performance. The purpose of this chapter is to discuss each of these basic issues. The issue of information proceeds under the assumption that existing regulatory policies and the industry structure in international communications are unchanged. The discussion of public policy issues is concerned with fundamental changes in the structure of the industry.

The Communications Act of 1934, as amended, and the Communications Satellite Act of 1962 grant certain legal powers to the Commission for the regulation of the international carriers. With regard to charges, practices, classifications, and regulations, the Commission, after full hearing, is

> authorized and empowered to determine and prescribe what will be the just and reasonable charge or the maximum or minimum, or maximum and minimum, charge or charges to be thereafter observed, and what classification, regulation, or practice is or will be just, fair, and reasonable, to be thereafter followed.[1]

This broad authority is reinforced by a recent amendment to the Commission's Rules that requires "a cost of service study for all elements of costs for the most recent 12 month period" for proposed tariff changes.[2] With respect to depreciation charges, the Commission "may, when it deems necessary, modify the classes and percentages so prescribed."[3] The Commission's authority over additions to existing facilities stems from Section 214 of the Communications Act. This section states, in part, that

> no carrier shall undertake the construction of a new line or an extension of any line. . . . unless and until there shall first have been obtained from the Commission a certificate that the present or future public convenience and necessity require or will require the construction, or operation, or construction and operation, of such additional or extended line . . . .[4]

The Satellite Act supplements the 1934 Act for satellite communucation and takes precedence if the two are inconsistent. The 1962 Act stipulates "that the corporation

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[1] Communications Act of 1934, as amended, 47 U.S.C. (1964), Section 202 (a).

[2] Federal Communications Commission, Rules and Regulations, Volume X, Part 61.38 (i).

[3] Communication Act of 1934, _op. cit._, Section 220 (b).

[4] _Ibid._, Section 214 (a).

created under this Act be so organized and operated as to maintain and strengthen competition in the provision of communications services to the public . . . ."[5] Further, the Commission shall "prescribe such accounting regulations and systems and engage in such ratemaking procedures as will insure that any economies made possible by a communications satellite system are appropriately reflected in rates for public communications services."[6] Finally, the Commission is instructed to "insure that no substantial additions are made by the corporation or carriers with respect to facilities of the system or satellite terminal stations unless such additions are required by the public interest, convenience, and necessity."[7]

With these broad statutory powers and an objective of monitoring the performance of the international firms, the Commission has the authority to require the carriers to submit information that will enable the Commission to carry out its regulatory function. Suggestions are proposed herein for more information on operating costs and investment costs, and for collection of information on demand, depreciation, and composite pricing not now collected.

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[5]Communications Satellite Act of 1962, 47 U.S.C. (1962), Section 102 (c).

[6]Ibid., Section 201 (c)(5).

[7]Ibid., Section 201 (c)(9).

The suggestions are offered with a view toward increasing the effectiveness of regulation in international communication under the current policies and market structure.

In the second major section of the chapter, changes in market structure and one major Commission policy decision are considered. Structural changes may be needed to improve industry performance if more effective regulation, based on the use of improved information, is unable to provide sufficient inducements to accomplish this objective. Three basic changes are advanced: removal of direct common carrier influence from Comsat, repeal of the Authorized User decision, and separation of AT&T's international operations to form an independent cable firm. The suggestions contained in this section are not advanced for the purpose of replacing regulation. The suggestions for structural change are offered as supplements to conventional methods that may be needed if a significant improvement in performance is to be expected. If any of these suggestions are adopted, regulation of the firms will still be necessary. It should be kept in mind that the suggestions in this section are offered as possible courses of action that could be taken. Each idea would require more detailed analysis before being considered for adoption.

Existing Market Structure

Cost Studies

High on the priority list of information needed to improve regulation in international communications is the development of detailed costs analyses to be undertaken by all firms on a periodic basis.[8] With the authority granted to the Commission and a responsibility to monitor performance of the firms, the costs of providing service must be known on a more detailed basis than the current aggregate totals. These cost studies, similar to the Seven-Way Cost Study, are essential if the Commission is to regulate the firms effectively and should be an extension of the continuous surveillance technique applied to AT&T's total operations.

The type of cost information used in Chapter IV is indicative of the current status of the information available. The need to rely on estimates of annual operating and maintenance expenses, the estimated investment cost figures for cables, the absence of any information on the costs incurred in replacing cable sections, the considerable difficulty in obtaining any cost information about the satellite system from Comsat, etc., emphasize the lack of adequate cost information and the need for detailed cost studies.

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[8] The Commission has requested the carriers to undertake cost studies of their international operations and these studies are currently in progress.

The cost studies should be more detailed than the estimates derived in Chapter IV. An extensive inquiry should be undertaken to ascertain the international investment, revenues and expenses, and net earnings of the various service categories of each firm. Preferably, these studies would also breakdown the costs and revenues by major service categories, e.g., transatlantic, Caribbean and South America, and Pacific. Within the cost categories, major components should be listed separately. For instance, satellite system investment costs could be separated into space segment costs, earth station costs, and costs of connecting links with the terrestrial network. Cable communication costs could be separated into transmission plant by individual cable and non-transmission plant.

The methodology for allocating common costs among the various service categories and geographic areas must be developed and explained in detail and any alternative methods should be presented. For example, the allocation could be done on the basis of relative use by dividing common costs between peak and off-peak periods. The service categories will vary among the carriers and the emphasis should be on insuring the use of consistent methodology. The services provided by the record carriers differs from the services of AT&T, and Comsat is still different in the services it provides.

In addition to allocating common costs among service categories, specific attention should be focused on the procedures used for separating the costs incurred in domestic communication from the costs involved in international communication. Certain costs will be directly assignable to the overseas sector. Some cost elements will be common to both and the procedures used for allocation need to be developed and explained in detail. To illustrate, the Seven-Way Cost Study and its subsequent modifications did not disaggregate sufficiently to permit any determination to be made on the overseas operations of AT&T. Obviously, any attempt to analyze AT&T's international operations requires a disaggregation of total costs into those costs incurred in providing overseas services.

Special attention should also be given to Comsat because of its multifunction role as carriers' carrier, manager of Intelsat and member of Intelsat. In addition, Comsat performs other services such as research for NASA. It will be necessary to scrutinize the procedures used to allocate costs and revenues among the categories associated with the functions performed by Comsat in order to determine the amounts correctly allocable to its international communications operations. Further, the nature of Comsat's business and the novelty of this communication medium warrant a careful analysis of the cost items included in the different cost categories. The inclusion of failed satellites in the Comsat rate base indicates the need for such a thorough investigation.

In light of the absence of any recent formal proceedings on international rates, the cost studies should be developed to serve a second purpose. The studies should be utilized to examine the relationship between costs and revenues for each firm. This relationship should not be based on the aggregate operations of the companies as with the traditional revenue requirement approach. The revenue allocation should be based on individual service categories by geographic locations and thereby be consistent with the cost procedures. The Commission will then be able to assess the existing rate structures in light of the continuous downward trend in transmission costs and the periodic rate reductions that have been implemented, primarily in private line services. In light of the potential for internal cross-subsidization both by service and geographic area, disaggregation of costs and revenues suggested here seems clearly warranted and should be undertaken by all international carriers if the Commission is to make informed decisions and to regulate effectively.

These cost studies, performed on a periodic basis, will enable the Commission to compile a continuous flow of information on cost and revenue figures. This data base can then be used as a basis for evaluating the cost projections included in applications for additions to existing facilities. Further, in conjunction with the traffic forecasts that should be included in the investment applications, a basis will be established for evaluating the impact of alternative rate schedules on traffic and revenue forecasts associated with each investment proposal.

A further benefit that may be derived from these periodic cost studies is in supporting negotiations on rate reductions. Illustrative of the negotiations was the condition attached to the authorization of the TAT-5 cable requiring a minimum reduction of 25 percent on transatlantic telephone service. More informed judgment will be possible if such rate reductions are based on the results of cost studies. Further, such studies may indicate that greater rate reductions are warranted. In either case, the lack of sufficient information on which to base these rate reductions serves to point out the need to undertake these studies, even if the Commission continues to rely on the negotiation process. More effective regulation will be a benefit of this type of improved information and data.

Demand Models

A second suggested step to improve the effectiveness of regulation in international communications is the development of demand models for each of the major services provided by the carriers. There will, of course, be a number of problems encountered in the development of demand studies. The elasticity of demand for the various services may be a function of the existing market structure. With a different market structure that results in more aggressive efforts to promote new markets and new services the demand elasticity may be entirely different. Thus, estimates of the various demand elasticities may be misleading because the markets have not been tested. The specification of the models and a determination of the relevant variables affecting international communication services may pose serious problems. There is also the difficulty of collecting appropriate demand data. However, if the problems can be overcome there will be substantial benefit gained from continuing demand studies.

The Commission should find these models invaluable in regulating the international carriers. With an accurate estimate of the demand elasticities the effects of variations in rate levels could be estimated more accurately. In the instance of the rate reduction accompanying TAT-5, a demand model may have been helpful in evaluating the impact on traffic of the 25 percent rate reduction and other alternative rate changes. The impact of rate changes can also be expected to have an important bearing on the analysis and evaluation of investment decisions.

The importance of investment in the growing international market emphasizes the need for accurate forecasting techniques that could be met by appropriate demand models. The timing of additions to capacity is vitally influenced by anticipated traffic requirements. Delays in additions may result in a deterioration of service while premature installation may produce substantial excess capacity thereby degrading efficient utilization of facilities. Further, with the pace of technological change inaccurate forecasts may lead to the installation of obsolete facilities that could have been avoided with better traffic estimates.

The current practice of the carriers in estimating future traffic requirements reinforces the need for demand models by the Commission. The general procedure of the carriers is to estimate requirements on the basis of historical growth trends without any adequate knowledge of the impact on the investment plans resulting from lower rates. Investment plans are then determined. This practice is not entirely satisfactory, particularly in light of the inaccuracy of the forecasts prescribed by AT&T and Comsat. In evaluating their traffic expectations for transatlantic traffic, AT&T tends to err on the low side while the Comsat figures tend to overestimate future demand. Further, the estimates are either based on no alteration in rates or the assumption that rate changes do not affect traffic volume. The assumption of an inelastic demand is subject to serious question in light of AT&T's recent experience with Great

Britain. The 25 percent rate reduction accompanying the installation of TAT-5 resulted in a traffic increase in excess of 40 percent. AT&T claims that the unanticipated increase was caused by the introduction of International Direct Distance Dialing. However, managerial judgment should be replaced by reasoned knowledge. Since the investment decision is basically concerned with the problem of when to install what facility for how long, with a given traffic forecast, the accuracy of that forecast assumes added significance. As a result, the development of accurate demand models would undoubtedly be a substantial aid in evaluating investment proposals.

Investment Applications

The long lasting impact of individual investments in transmission plant and their effect on existing capacity as the scale of facilities increases makes the evaluation of investment applications crucial. A detailed appraisal of individual applications requires an increase in the amount and type of information presented with the applications. Currently, demand forecasts and investment cost figures for individual facilities are included in the applications; for instance, the investment costs of a cable or the estimated cost of a satellite. The investment cost estimates should include, in addition to satellites, earth stations, and cables, any additional investment cost that must be incurred as a result of an expansion in transmission plant. For example, alterations or additions to interconnection facilities may be necessary to link the international system to the domestic distribution network. The costs are part of the investment decision. The launching of a satellite with increased capacity may require alterations to some earth stations in order to handle the anticipated increase in traffic volume. In turn, additions to the interconnection facilities that link the earth station to the domestic network may be necessary. A similar adjustment may be required with the installation of a new cable. Additions to plant between the cablehead and interconnection to the domestic network should be clearly identified in the application. In short, all investment costs should be included in facility applications rather than just the transmission plant costs as is the current practice.

A second cost category, not currently a part of the information submitted in facility applications, should be required. The estimated annual operating and maintenance costs, exclusive of the return on investment, should be submitted to the Commission as part of the applications for additions to capacity. In order to allow an accurate appraisal of investment alternatives all operating costs associated with a particular facility must be included. For a satellite addition, the operating costs should be included not only for monitoring the satellite but also the costs associated with new earth stations to be installed with the satellite and those costs for maintaining the interconnection facilities. In the event of competing applications that are mutually exclusive, higher investment costs of one may be offset by lower operating costs. In other words, there may be some trade-off in these two basic cost categories. In the absence of information about annual operating costs an informed decision cannot be made. Further, an incorrect evaluation may be the result if investment costs are the only costs analyzed.

. Demand forecasts are currently a part of the facility applications. However, as already indicated, these forecasts are generally subject to a substantial element of error due to both uncertainty and methodology. In light of the inaccuracies, it may be wise to require an explicit discussion of the methodology and assumptions used in deriving the traffic estimates. In addition, until adequate demand models are developed a range of traffic forecasts may be more realistic than the precise circuit estimates presented by the applicants.

Composite Rates

The composite rate making formula should be thoroughly analyzed and the preceding information suggestions will serve as a basis for this examination. The philosophy behind this pricing formula is that all users should benefit from reduced rates emanating from a reduction in the cost of service regardless of the source, i.e., cables or satellites. This policy is in keeping with the objective that the economies of the satellite system should be reflected in the rates charged for public communications services as stated in the Communications Satellite Act of 1962. Since Comsat is generally precluded from direct access to the market, the composite pricing formula requires the international common carriers to integrate the costs of leased satellite circuits with the costs of their own cable facilities to the benefit of the user.

The composite pricing formula offers a workable approach as an interim pricing policy until better information is available on which to evaluate its effects. In essence, composite pricing is a solution in the absence of sufficiently detailed cost information. However, there may be some serious shortcomings in implementing, monitoring, and evaluating composite pricing in the absence of detailed cost data. In its conception this pricing principle is meant to average the cable and satellite technologies. With the cost information currently available, it is difficult to determine how the costs of the two technologies and the different vintages of capital within each technology are combined in order to determine the final rates. The resulting rates are not an arithmetic average, but rather a tendency toward uniform rates that vary among different geographic areas. There is no way of determining the price-cost relationship between different areas and different services. Further, it is difficult to analyze how rates vary with technology, economies of scale, and load factors as was intended by establishing the composite formula. In short, something is being averaged but the existing cost data makes it difficult to determine what is averaged and how actual rates reflect this average in practice.

Until the cost data suggested herein becomes available, composite pricing may be the only solution. Detailed cost studies will aid in understanding the nature of this pricing formula. Further, such studies may indicate that more sophisticated forms of pricing should be adopted that are cost related. With improved information a more efficient pricing scheme can be expected to do a better job.

Depreciation Policy

The depreciation practices employed by the firms in the international communications industry are based on straight-line accounting methodology. In an industry characterized by significant, periodic advances in technology, straight-line depreciation over a long period of time is clearly inappropriate. While it is difficult to determine the productive value of an asset that accurately reflects physical wear and tear, obsolescence, and changes in consumer demand, it is clear that the current practice of writing-off a cable in equal annual installments over a period of twenty-four years shares little correspondence with reality.

The current practice ignores the impact of obsolescence caused by the technological advances taking place in both cable and satellite equipment. The consequence of ignoring obsolescence and the continued use of straight-line depreciation is that obsolete facilities are used in providing overseas communications services. The accounting costs estimates derived in Chapter IV indicate this possibility by emphasizing the relative differences among facilities. The implication of these results is that a more realistic allowance for obsolescence would call for increased depreciation expenses in the early years of asset life matched by lower allowances in later years.

Inasmuch as the Commission has the authority to set depreciation charges of the carriers, an inquiry should be made into the depreciation practices being used for international communications facilities. The factors to be studied should include the following:

1. The rationale for the current practice of straight-line depreciation in the presence of advances in both cable and satellite technology.

2. The allowance for obsolescence in annual depreciation charges.

3. The timing of annual charges over the life of the capital equipment.

4. The effect of existing and alternative depreciation practices on the rate levels.

5. The depreciation period of the captial equipment.

6. An analysis of alternative depreciation policies that are more in line with the realities of the circumstances in international communications.

In all probability, an analysis in these areas will indicate that a new depreciation policy, more reflective of actual circumstances, is warranted and should be adopted.

Alterations in the Status Quo

The foregoing discussion was concerned with suggestions for increasing the quantity and quality of information and data made available to the Commission by the international carriers. The objective of these information suggestions is to increase the knowledge and allow more informed decisions to be made by the Commission. With the grants of power set forth in the Communications Act of 1934, as amended, and the Satellite Act of 1962 the Commission has the authority to implement each of the suggestions and thereby expand its information.

The second main section of this chapter is concerned with possible changes in the existing market structure. The Commission, by itself, does not have the authority to implement each of the changes that will be suggested in this section. Congressional action is required in at least one instance before further action can be taken. Thus, the Commission is somewhat restricted in its authority.

The point has been made that the international communications industry is cartelized and competition in the consumer market, both intermodal and among firms, has been curtailed. The sole potential for competition is among the record carriers in the non-voice market. Comsat is, for all practical purposes, foreclosed from the commercial traffic market. Further, rate of return regulation encourages preferences for facilities that are not necessarily based on either efficient investment decisions or efficient operating decisions. Unless enlightened regulation is able to produce a significant improvement in the performance of the firms in this industry other fundamental policy issues must be considered, beyond the suggestions made in the previous section. In particular, the structure of the industry must be examined for possible alteration if improvements are not forthcoming. Suggestions are advanced that may stimulate the international carriers to improve industry performance.

Comsat's Board of Directors

At the time Comsat initiated satellite operations in 1965, a number of communications common carriers owned Comsat stock. AT&T was the largest individual owner with 2,895,750 shares. The other major common carriers owning Comsat stock included ITT (1,050,000 shares), GT&E (381,250 shares), RCAC (250,000 shares), Hawaiian Telephone (50,000 shares), and WUI (30,000 shares). In addition to owning

Comsat stock, six members of the fifteen-man Comsat Board of Directors were elected by the common carriers. Three of the common carrier members were representatives of AT&T, one was the President of Hawaiian Telephone, one was an executive of ITT, and the last one was a business consultant.

With the passage of time most of the major common carrier stockholders divested themselves of Comsat stock and by 1970 only AT&T and ITT continued to hold stock. ITT sold its remaining 100,000 shares in 1971 leaving AT&T as the sole major common carrier stockholder. Common carrier representation on the Comsat Board was also reduced as a result of the stock sales. This representation on the Board dwindled to three members in 1971 with the ITT sale.

AT&T was the notable exception to this trend in common carrier stock ownership and representation on the Comsat Board. AT&T continues to hold its original investment of Comsat stock, 2,895,750 shares, and now has all three of the representatives on the Comsat Board elected by the common carrier stockholders. One of the three, R. R. Hough, is the President of the AT&T Long Lines Department.

AT&T is in a unique position as the single largest holder of Comsat stock and as a member of the Comsat Board. It is not unreasonable to conclude that AT&T is not interested in Comsat stock as a financial investment on which it can earn a return. The magnitude of AT&T's assets and operations minimizes the significance of any financial objectives that can be derived from the Comsat stock but there is another reasonable explanation for this stock ownership. The predominant implication is that the stock ownership and the resulting representation on the Comsat Board give AT&T an opportunity to influence the action of Comsat in international communications. AT&T is in the position of having direct access to the operating and policy decisions of Comsat. This inside position gives AT&T the opportunity to directly influence the policy decisions of Comsat, by itself and by influencing other Board members. AT&T's role as a member of the Comsat Board may enable it to receive information not otherwise available to it as an outsider. As the competitor of Comsat in the provision of transoceanic communications facilities, the opportunity to influence satellite policy and the mere knowledge of this policy may prove invaluable in formulating its own strategy and objectives.

The independent operation of Comsat requires a change in the ownership situation of this firm. In its initial stages of organization and operation the experience of existing common carrier entities may have been helpful in formulating policy directions for satellite communication. However, Comsat is beyond the stage of development. If the satellite firm is to operate independently and make its own decisions on the communication policy to pursue, then direct influence of AT&T, with its own objectives, in the decision making framework must be removed. Accomplishment of this goal requires the divestiture of all Comsat stock by AT&T. Removal of AT&T from the Comsat Board of Directors must accompany this sale of stock.

The removal of AT&T will not solve all the problems that exist in this industry. However, an environment will be established in which Comsat can make its decisions independently. At the very least, the potential for collusion or compromise between AT&T and Comsat with the existing organization is reduced.

The present organization and stock ownership of Comsat were stipulated by Congress in the Satellite Act of 1962. The exclusion of common carriers from both a financial investment in Comsat and representation on its Board of Directors will, therefore, require Congressional action because the Commission does not have the authority to take such a step. The Commission is empowered to propose that such action be undertaken.[9]

Common Carriers' Carrier Status of Comsat

The Satellite Act of 1962 authorized Comsat to furnish satellite circuits to the common carriers and other

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[9] Communications Satellite Act, *op. cit.*, Section 404 (c).

authorized entities. Section 103 of the Act states that the ". . . term 'authorized carrier'. . . means a communications common carrier which has been authorized by the Federal Communications Commission under the Communications Act of 1934, as amended, to provide services by means of communications satellites." Thus, the task of defining "other authorized entities" was left to the Commission. The decision was reached to prohibit Comsat from providing service to the final user except in unique and exceptional circumstances. The Commission, therefore, has the authority to reinterpret this decision, within the provisions of the Satellite Act, under different circumstances than existed at the time the initial decision was made. Prior Congressional action is not necessary.

The Authorized User decision relegated Comsat to the primary role of leasing satellite circuits to the common carriers. One consequence of this decision was to establish a unique commercial relationship between AT&T and Comsat. AT&T, the principal investor, decision maker, and user of the competing cable technology, is the single largest user of commercial satellite circuits. Of the half-circuits leased by the U.S. international carriers on Atlantic Basin satellites in 1968 and 1969, AT&T leased 88.8 percent and 75.7 percent of the circuits in use in these two respective years.[10]

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[10] Report to the President and Congress, 1968 and 1969, Communications Satellite Corporation.

In a very real sense, the financial viability of Comsat is dependent on the use of satellite circuits by AT&T. Unless AT&T uses satellite circuits, and in large numbers, these facilities would operate with substantial excess capacity. As indicated in Chapter IV, satellites tend to operate at lower levels of capacity than cables and the difference is substantial in most instances. Cable capacity has tended to be utilized at very high levels while excess capacity has been the general rule for satellites.

The ability of Comsat to overcome the problem of unused capacity is severely restricted by the general limitation to serving common carriers. Direct access to the market will afford Comsat the opportunity to encourage the use of satellite circuits and thereby increase the level of utilization. Further, rescinding the restriction on Comsat would tend to encourage intermodal competition that does not presently exist in the international communication market. The possibility for realizing any potential benefits of satellite communication would tend to be enhanced if the firm primarily responsible for satellite development were free to exploit the technology. Of course, a decision would have to be made by the Commission on whether the proportionate fill policy should be continued and, in addition, the proper timing of new facility installations would remain. However, Comsat would be given the opportunity to decrease its spare capacity.

Initially, the response by Comsat to direct market access would most likely be in two main services. One service would be television transmission. This service is relatively small in terms of the total volume of business in international communications but it is growing. Rather than supplying satellite circuits to the common carriers, who in turn meet network requirements, Comsat could go directly to the network thereby removing the middleman. For this service there would be no competitive confrontation because overseas cables do not presently carry television transmission. However, the second service would be different.

The second potential service is more significant. This service is the private line market of the record carriers and AT&T. As previously mentioned, the record carriers are the sole source of leased circuits for non-voice use and alternate voice data (AVD). Allowing Comsat to enter this segment of the overseas market may pose a problem similar to the one resolved by the TAT-4 decision. Namely, if the terrestrial carriers choose to lease satellite circuits for resale as private line circuits they will be unable to compete with Comsat. The record carriers would be placed in the position of leasing satellite circuits at the same rate Comsat offers to potential customers. However, there is a difference between the present condition and the one existing at the time of the TAT-4 decision. In the present instance, the record carriers own cable circuits and lease satellite circuits. If, as the international carriers proclaim, it is less costly to own cable circuits than to lease satellite circuits they should have no difficulty in meeting any competitive threat posed by direct Comsat entry into the private line market. The international carriers are virtually unanimous on this point. Indicative of their positions are the following excerpts:

> As a matter of fact, WUI's costs of rendering service via satellite are substantially higher than those via cable. There is a wide cost disparity in favor of cables for circuits owned by WUI.[11]

> But RCA Globcom notes that its present per circuit costs for cable circuits are substantially lower than the per circuit costs for satellite circuits.[12]

> Careful consideration has been given to the relative costs to us of using cable and satellite facilities in international services. We submit that at present the comparison clearly favors cable circuits.[13]

Thus, Comsat entry should pose no threat to the financial viability of the record carriers. The non-voice communications markets, currently reserved for the record carriers

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[11] Letter from Robert E. Conn, Western Union International, to Walter R. Hinchman, Office of Telecommunications Policy, March 22, 1971.

[12] Letter from E. F. Murphy, RCA Global Communications, to Walter R. Hinchman, Office of Telecommunications Policy, March 18, 1971.

[13] Letter from B. H. Oliver, Jr., American Telephone and Telegraph Company, to Walter R. Hinchman, Office of Telecommunications Policy, March 24, 1971.

by the TAT-4 decision, would be open to all international carriers. The firm capable of providing the services at a lower cost would presumably meet the requirements of the users in the absence of significant differences in the quality of service.

A potentially significant effect of permitting Comsat to go directly to the market is the incentive to promote the use of satellites through the introduction and development of new international services and markets. Whereas the first two services may tend to expand satellite usage at the expense of cable usage, this third possibility provides the potential for expansion of communications services beyond those currently being offered by the common carriers. An aggressive effort on the part of Comsat and the use of various incentive pricing techniques offers a vast potential to reduce the reliance of Comsat on AT&T while expanding the utilization of capacity over the life of a satellite. If Comsat is successful in its attempts to establish new services, given the opportunity, it may be possible to reflect a higher rate of satellite utilization in lower lease rates, to both the common carriers and the final user.

Providing Comsat with the opportunity of direct access to the market does raise the potential for internal cross-subsidization of services by Comsat and the carriers. Comsat, in an attempt to attract customers, may establish rates for satellite services (using subdivided circuits) to the final user at discriminatory low levels. Its monopoly service of leased satellite circuits to the common carriers could be used to meet its overall revenue requirements thereby compensating for the rates on services to the final user. History indicates the distinct possibility of such an occurrence. The so-called 48 kHz case is an example of Comsat employing discriminatory pricing practices.[14] Of the common carriers, AT&T is in the best position to use such pricing tactics to combat any threat posed by Comsat. With its monopoly in voice communications, AT&T is in an ideal position to use its overseas voice service to subsidize leased services if the need arises. In the event that Comsat enters the leased service market, the potential for cross-subsidization must be recognized by the Commission and steps taken to minimize the possibility of abuse.

A Separate International Cable Firm

The development of the international telecommunications industry has resulted in a cartelized industry in which AT&T is the dominant firm. The market structure of the industry has been altered by the entry of Comsat and the availability of satellites as an alternative mode of communication to submarine cables. However, the satellite technology

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[14] ITT World Communications, Inc., *et al.*, 30 FCC 2d 101 (1970).

was essentially integrated into the operations of AT&T with the Authorized User decision. The limitations placed on Comsat by this decision generally preclude it from direct access to the communications markets and, in effect, make Comsat a vertical affiliate of the common carriers, primarily AT&T.

The dominant position of AT&T in international communications is further enhanced by its monopoly of domestic communications. The international communications operations of AT&T are integrated with its domestic operations. In terms of relative magnitude, the international operations are only a small portion in comparison to the domestic business of the Bell System. Although AT&T does have a virtual monopoly of international voice traffic, the monopoly power of this company is the result of its domestic communications. The international voice monopoly is an extension of its domestic position.

The market structure in international communications and the enormity of AT&T's total operations are two principal causes of the decision making framework in which investment and operating decisions are made. AT&T is the domiant firm and its investment decisions are aimed at maintaining this position. As previously noted, AT&T is limited to increasing its capacity with cables because the satellite is not available as an investment alternative. No return is allowed on leased satellite circuits thereby creating a bias in favor of owning cables as opposed to leasing satellite circuits. The investment decisions of AT&T are directed toward the continued use of submarine cables with the stated objective of insuring a continuous 50/50 balance of cable and satellite circuits. This objective of "reasonable balance" is a matter of corporate policy rather than a means to meeting international communications requirements with a network that minimizes costs while meeting certain policy objectives, e.g., rapid development of a world-wide satellite system.

The position of AT&T as a supplier of domestic and international communication services tends to distort its decision making framework. The magnitude of AT&T's domestic operations relative to its international business makes submarine cable investment decisions almost insignificant. To illustrate, the estimated construction cost of $86.0 million for TAT-6 (AT&T's portion would be less depending on ownership interests) is small in comparison with an investment program of $7.7 billion for the total operations of the company in 1971, and a comparable program of $8.2 billion for 1972. If a bad investment decision is made or an unrealistic depreciation policy is used for international facilities, the adverse impact on total operations is negligible. Furthermore, the magnitude of its domestic operations and the ability to combine international and domestic operations allow AT&T to offset any bad investment decision in international communications. Obviously, no investment in international facilities will be undertaken if prior expectations indicate that the project is not economically feasible. However, the significance of an error is substantially reduced if it is known that a loss can be subsidized by domestic operations. The risk of any single project is ameliorated.

The results of the decisions made within this framework indicate that a change in the market structure may be necessary if industry performance is to improve. The depreciation policy for each cable is on a straight line basis over a twenty-four year period. This policy is clearly unrealistic in light of the numerous technological advances that have occurred in overseas communications facilities. The empirical results of the accounting unit cost estimates and the output-input index point out the existence of significant differences among currently used transatlantic facilities. The investment objective of maintaining a 50/50 circuit balance in order to insure the use of cables that is not needed to meet expected traffic requirements illustrates the expected results from an adherence to the circuit balance objective. The operation of facilities further reflects the results of the decision making framework in international communications. Facilities that have been surpassed by advancing technology are being utilized at a high level of capacity while newer facilities are only partially employed. Finally, there has been a notable reluctance to adjust user rates in the face of the technological advances embodied in the additions to capacity. The rates for major service categories, message telephone service and leased satellite channels, have not been voluntarily reduced. The reductions that have occurred were the result of conditional authorizations imposed by the Commission on investment grants. The Commission authorized TAT-5 on the condition that message telephone rates be reduced by 25 percent, private line rates be reduced by more than 25 percent, and telex rates be reduced by at least 15 percent. The Commission used the initial launch of the Intelsat IV satellite to reduce Atlantic Basin leased channel rates by 25 percent. The combination of increasing productivity and reductions in unit costs indicates that rate reductions should have been forthcoming from the international firms.

The implication drawn from the behavior of AT&T is that its performance can be substantially improved in the provision of international communications services. Market structure is a significant causal factor in the decision making framework which, in turn, influences the performance of an industry. With the unique structure and organization of the existing international communications industry and the position of AT&T, alternations in the status quo, beyond the previously indicated changes, may create incentives that will produce a desirable improvement in performance.

The market structure in international communications has been examined both before and after the creation of Comsat and two basic recommendations for change have been advanced. Various proposals have been advanced for permissive legislation to allow the merger of international telegraph carriers.[15] To date none of these proposals has resulted in the necessary Congressional action. Going beyond the merger of the telegraph carriers has been the recommendation that facilities used in international communications be consolidated into a single firm.[16] This monopoly proposal deals only with transmission facilities. The transmission plant of the international voice and telegraph carriers would be consolidated with the satellite

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[15]For a summary of the merger proposals see Asher H. Ende, "U.S. International Communications: Regulation," Law and Contemporary Problems, Part I, Spring 1969, and George E. Ashley, "International Communications: What Shape to Come?," Law and Contemporary Problems, Part I, Spring 1969.

[16]This proposal has been suggested by Merton J. Peck, "The Single-Entity Proposal for International Telecommunications," American Economic Review, Papers and Proceedings, May 1970, and by the President's Task Force on Communications Policy, Final Report, December 7, 1968.

investments of Comsat, the U.S. earth stations and other requisite equipment like switching plant. After the transmission plant is merged into a monopoly firm, the international carriers would be free to decide whether to remain in operation and use the facilities of the monopoly or drop out of business entirely.

The rationale of these proposals is that by reducing the number of firms and consolidating more power into fewer hands, performance in the industry will improve. Various arguments have been presented in support of each proposal. For example, in support of the single entity proposals, the argument is advanced that the monopoly firm will be in a position to choose between a satellite and a cable in specific instances. The preferences that currently exist, because investment choice is not possible, would be eliminated. The implicit assumption is made that the monopoly firm will be a profit maximizer and, therefore, select the least cost alternative in adding to the communication plant. Other benefits are also expected to result from the monopoly firm. Among these benefits are the realization of available economies of scale, advancement of U.S. foreign policy objectives, and more effective government regulation.

The single entity proposal is not without drawbacks. Under the existing method of regulation, the incentive to unwarranted rate base expansion remains. It is not clear that the monopoly firm, in a position to choose between satellites and cables, will select the lower cost alternative when absolute profit levels are dependent on the size of the rate base. If the monopolist is a profit maximizer, subject to the regulatory constraint on its rate of return, the firm may be inclined to select the alternative leading to the largest increase in its rate base. Indeed, the distortion in investment criteria inherent in rate of return regulation can be expected to produce a misallocation of resources in the form of over-investment.

The problem of rate base expansion may be even more significant than the present concern with the existing market structure if the single entity adopts a policy similar to the one advocated by AT&T. If additions to capacity are aimed at maintaining a reasonable balance (i.e., 50/50) between satellite and cable circuits, substantial excess capacity of prolonged periods could easily result, particularly with the tendency toward ever increasing capacities of individual facilities. In consequence, if the market is limited relative to existing capacity, potential economies of scale will not be realized.

There may be detrimental effects on the development and application of technological advances if all competitive pressures spurring advancement are removed. The monopoly firm will have discretionary control over technological change and its incorporation in new facilities. The removal of competition may retard the rate at which advances are made and put into operation thereby slowing the realization of gains in efficiency. Further, the monopoly firm will not be under pressure to introduce new services that take advantage of the characteristics inherent in a technology.

The adoption of a realistic depreciation policy, a serious problem with the current market structure, will not be resolved if one firm has complete control over all technologies and the introduction of facilities embodying new advancements. The monopoly firm would be subject to even less pressure to adopt a depreciation policy that accurately reflects actual events. The potential for an inflated rate base and use of equipment that is economically obsolete can be expected to increase.

Finally, in the absence of any competitive elements, the monopoly firm will have substantial flexibility in setting rates. With discretionary control over prices, the abuses of monopolistic price discrimination may seriously affect efficient use of the international communications network. Further, there will be little pressure to reduce rates in line with cost reductions and adopt a pricing policy that reflects communications costs unless the Commission diligently regulates the rate structure.

In sum, there are several reasons to conclude that a monopoly firm in international communications will not significantly improve performance in this industry beyond current levels. The potential gain from allowing one firm to choose between satellites and cables in its investment decisions seems small in comparison with the potential for misuse of monopoly power.

There are four market structures possible in the international communications industry: the existing market structure, a single entity, a duopoly in which each firm is free to invest in cables and satellites, and a duopoly in which each firm is restricted to one technology. The analysis of the current situation clearly indicates the need to examine other possibilities. As shown in Chapter II, the current organization, the relationship of Comsat and AT&T, and restrictions on Comsat are not conducive to the development of an optimal communications network. The analysis of investment policies in Chapter III points out the tendency toward over-investment and the consequent impact on realizing potential economies of scale. The depreciation policies were also seen to be unrealistic. Chapter IV revealed the simultaneous use of facilities embodying a range of technological advancement. The more advanced facilities were not operated efficiently, nor was the mix of facilities operated in a manner that would minimize costs. The overall conclusion was a need to seek other alternatives.

The second possible market structure is a single entity of all U.S. international communications. The concentration of monopoly power and the potential for abuse of this power, as previously discussed, indicate the need to seek further alternative market structures. The conclusion that maintaining the status quo and an international communications monopoly are undesirable alternatives leaves two other possible market structures.

An alternative to these proposals is a restructuring of the international communications industry that will create a different decision making framework and make the firms more responsive to market forces. The separation of AT&T's international communications operations to form a new international enterprise will serve to promote such an environment. The source of AT&T's monopoly power will be removed by separating its domestic and international operations.

The separation of AT&T's international operations is the basis for the remaining market structures, the two duopoly arrangements. The duopoly market structure could take either of two forms. On the one hand, the new enterprise could be permitted to invest in cables and satellites. Comsat would also be permitted to choose between satellites and cables in its investment decisions. On the other hand, the new enterprise could be restricted to cable investment.

Comsat would continue to be the sole U.S. international satellite firm. Under both alternative market structures, the firms would be free to enter any international market, e.g., leased circuits, voice communications, data, private line, etc., and supply any customer. An analysis of the pattern of resource allocation will indicate possible differences to be expected from these two market structures.

The first duopoly market structure (the third alternative market structure referred to above) allows both firms to choose between cables and satellites in making investment decisions. It is assumed that each firm will select the least cost alternative in determining its mix of facilities. A further assumption is made that two potential legal barriers will not inhibit a duopoly satellite arrangement. One barrier is the chosen instrument policy for international satellite communications established in the Communications Satellite Act. This policy would have to be changed by Congressional action. Second, the creation of Intelsat as a global satellite system could also present difficulties in the establishment of a second U.S. satellite firm. In order to assess the economic impact of a duopoly market structure, it would have to be assumed that these two legal barriers can be overcome.

At the abstract level, this alternative should lead to each firm installing the most efficient facilities in the various communications areas, i.e., Atlantic, Pacific, Caribbean, etc. In making an investment decision, each firm would select the lowest cost facility for each different communication area, given the market conditions. However, realization of all economies of scale may not be possible.

The extent of the market in each of the major communications areas may impose a limitation on the realization of all economies of scale. There is a trend toward larger capacity facilities for both cables and satellites. The market for international communications services is also growing at a very rapid rate. However, the various markets may not be sufficient to support two competing firms in a manner that allows for the realization of all scale economies over a significant portion of the system lives. The potential for excess capacity may be serious depending on the magnitude of the markets relative to installed capacity.

Consider, for example, the potential for excess capacity if both firms simultaneously install satellite systems of the current capacity in a communications area, say the Atlantic Basin. Each system would require its own earth stations leading to the possibility of redundant ground terminals. Each firm would, undoubtedly, launch a spare satellite for service protection so there would be a redundant spare satellite. Moreover, with both firms supplying the same market with the least cost alternative, the potential for excess capacity in the operational satellites over a prolonged period presents a very real problem. Ideally, the launching of satellites should be timed to meet demand as it exceeds the capacity of existing facilities. Under the duopoly arrangement being discussed, this kind of timing would not be expected. Both firms are making investment decisions on the basis of the least cost alternative but the market will limit the possibility of a maximum realization of all economies of scale.

There is, additionally, a tendency toward over-expansion of the rate base inherent in rate of return regulation. If this incentive is strong and both firms are influenced by it, the tendency toward over-investment is exacerbated. The consequence could be substantial excess capacity for prolonged periods of time and capacity would not be efficiently utilized.

At the practical level, one potentially significant problem, with respect to facility installations, may result from this duopoly arrangement. As discussed in Chapter III, Comsat is firmly convinced that satellites are the least cost mode. Comsat may not consider cable investments as an alternative. Satellites may be its only form of investment, even with the availability of a choice. If this condition occurs, one firm will be selecting the least cost alternative while the other firm chooses satellites in all situations. Investments could become distorted and the potential for over-investment, excess capacity, and unrealized economies may be intensified.

The worst possible situation could develop if both firms discard the least cost criteria in favor of the circuit balance criteria presently advocated by AT&T. The consequence would be a quasi-cartel arrangement in which the market share of each firm would tend to become stabilized. Moreover, unless markets expand substantially more rapidly than expected, redundant capacity would be abundant. Investment decisions would not lead to an installation of efficient facilities unless, of course, there are no cost differences between the investment alternatives in all communications areas. Even in the event of no cost differences, the excess capacity problem is likely to be acute.

Under the second duopoly market structure (the fourth alternative market structure referred to above) there is no need to assume a least cost basis for investment decisions because the firms are not in a position to choose. Each firm can install only one mode of communication. The assumption is made that each firm adopts a pricing policy that accurately and fully reflects the costs of providing facilities and services in its rates.

At the abstract level, this market structure should result in an installation of the most efficient facilities in the various communications areas. If the two technologies have inherent cost advantages in different communications areas under different market conditions, these advantages will be reflected in the investment patterns. If cables are more efficient in short distance situations, e.g., the Caribbean, they would be used to meet requirements in such areas. Conversely, if satellites are more efficient in long distance situations, e.g., the Pacific, they would be installed in these areas. In the case where the technologies are equally efficient, some mix of facilities would be expected, provided the market is sufficient to support the capacity of both.

The potential for excess capacity and redundant facilities is not as great under the second duopoly market structure as it is under the first duopoly where both firms can choose between the alternatives. The market factor is not as limiting because the possibility of both firms providing equivalent facilities to meet given requirements is removed. The redundancy in earth stations and spare satellites is not present. Furthermore, rates reflect the actual costs of service and the firm employing the higher cost technology would not be inclined to install a facility requiring higher rates in a given communication area. Both firms would be potential competitors for the same actual markets but the firm with lower costs, and hence lower rates, would provide service to the areas in which it has a comparative cost advantage. Economies of scale would be realized to the extent allowed by market conditions.

Rate of return regulation continues to provide an incentive to over-invest. The tendency toward excess capacity and a dilution of scale economies is possible. However, the magnitude of over-investment may not be as great if each firm is restricted to one technology thereby removing the possibility of duplicative investments.

At the practical level, investment policies of the two firms may be directed toward securing some portion of a market. Comparative costs may not be the determining factor to the firms, i.e., one firm may think the alternative technology is more efficient in a given situation but ignore the comparison in its investment decision. However, comparative costs, as reflected in rates, would determine which firm actually serves the market. The firm installing the high cost technology would suffer in competition with the low cost firm. In this manner, the market would tend to direct resources to those communications areas reflecting comparative cost advantages.

A second practical problem deals with foreign policy aspects of international communications. The cable firm would have the responsibility of conducting negotiations with interested foreign correspondents. Each cable landing on foreign soil would necessitate negotiation of termination agreements with foreign authorities. AT&T currently conducts these negotiations for each new cable installation and the new cable firm would have to assume this responsibility.

Ownership of existing cables must be considered in connection with the second duopoly arrangement. Several cables are more costly relative to the more technologically advanced facilities, and potentially obsolete. Forcing the new cable enterprise to purchase these cables from AT&T would place the firm in a disadvantageous position vis-a-vis Comsat. The firm would find itself at a competitive disadvantage if forced to use these facilities. If the new enterprise assumes ownership of these cables, an incentive is created to seek a method of subsidizing the write-off of the older cables. The logical step for the new enterprise is to set rates, in areas where cables have a comparative cost advantage, at a level that covers this write-off. To illustrate, assume cables are the low cost alternative, relative to satellites, in the Caribbean area. Rates on communications services could be set at a level to cover the write-off of the older transatlantic cables. If rates are set to reflect the most advanced technology, this type of cross subsidization must be avoided.

One method of avoiding this possibility is to establish rates on the basis of the lowest cost facility in each communications area. This method would necessitate an increase in the amount and type of information reported by the carriers to the Commission along the lines previously suggested in this chapter.

Another method of accomplishing this objective is to set the sale price of the older cables on the basis of the most efficient alternative in each communication area. The sale of the transatlantic cables to the new cable firm, for example, would be based on the lowest cost facility (on a per circuit basis) then in operation in this area. A similar method would be used for other communications areas. The cost of the cables would then reflect current costs and the adoption of a realistic depreciation policy. The loss involved in the sale should be borne by the investors of the companies selling the cables. In this way, the companies are responsible for the unrealistic depreciation policies and not the new enterprise. The cables could then be phased out of operation in accordance with new technological advances.

Under ideal conditions, both duopoly market structures appear to produce essentially the same results, provided the market is sufficiently large to support two firms in a position to choose between cables and satellites. However, there appears to be a greater potential for excess capacity, redundant facilities, and unrealized economies of scale if both firms can invest in cables and satellites because they will be competing for the same markets with the same facilities. Consequently, the second duopoly market structure appears to be preferable.

The loss of monopoly power, occasioned by the spin-off of AT&T's international operations, will place the new enterprise in a new decision making framework. Two additional market conditions will force a decision making framework that differs from the existing one. First, if international communications services are supplied by this new firm, the potential for internalizing decision making errors will be substantially curtailed. Under existing conditions, AT&T has the ability to internalize mistakes because its domestic and international operations are consolidated into the total operations of the company. The portion of total business derived from the provision of international services is relatively small. In consequence, if the forecasts of future events associated with a particular cable investment do not correspond with the development of actual events, the errors can be offset by domestic operations. The adverse impact of a bad investment decision is almost imperceptible because the error is sufficiently insulated by the enormity of AT&T's total operations.

The most apparent decision making error of AT&T in its international operations is the use of straight line depreciation over a twenty-four year period in an environment of dynamic technological change. The totally inadequate allowance for the obsolescence factor in the annual depreciation expense raises the potential for continued use of facilities that have been rendered obsolete by new transmission equipment that embodies the most recent technological developments. The adverse impact of using obsolete equipment with net historical unit costs that exceed the current unit costs of the latest technology has minimal effects on overall operations. The investment error can be internalized. In short, if mistakes are made in investment decisions, AT&T is in a position to cross-subsidize the international operations by absorbing them into the domestic operations. Decision making errors can be internalized by the company without suffering the adverse consequences that a firm, not in a similar position, would have forced upon it by market pressures.

If the new, separated firm is not in a position to internalize its errors, a different decision making framework is established. The financial viability of the firm will be dependent on the provision of international communications services only. Alternative means of meeting expected traffic requirements will have to be carefully evaluated because the risk of making a decision error is greater and the consequences to the viability of the firm are more serious. The firm will not be in a position to cross-subsidize investment errors. The firm will be under greater pressure to base its investment decisions on the least cost alternative in order to provide communications services at low rates rather than formulating its investment plans with an objective of maintaining an artificial 50/50 balance of cable and satellite circuits. Further, as part of the investment decision, a more realistic appraisal of the impact of technological advance on depreciation policy should result because the consequences of using obsolete facilities can no longer be offset by domestic operations.

The second condition that will promote a different decision making framework is the direct access of Comsat to the final market. The effect of eliminating the restriction on Comsat will be to create the environment for direct intermodal competition between cables and satellites. The market pressures resulting from this competition will put a premium on the investment decisions of both firms. If the depreciation policy employed by the new enterprise is not an accurate reflection of technological realities, the firm will be faced with a stockpile of obsolete capital on the books that cannot be used for competing services. The firm will not be in the position to internalize the error as it can under the existing market structure. If prices accurately reflect the costs of providing international communications services and cross-subsidization among services is not possible, the rates for competing services will have to be comparable or a loss of business will result. The decision making framework of the proposed market structure will increase the importance of investment decisions and the evaluation of investment alternatives because each firm will be fully accountable for the consequences of its decisions and any errors it may make.

These two conditions, taken together, will tend to complement each other and lead to an improved decision making framework. On the one hand, the ability to internalize decision errors with domestic operations is removed. The effects of investment decisions, including depreciation, must be borne entirely by the international operations of the firm. However, the potential for the new firm to internalize errors may still be present. The degree to which the firm can offset bad decisions is reduced but the market pressures tending to force the firm into an improved decision making framework may still be weak. On the other hand, direct intermodal competition between cables and satellites will provide the pressures needed to promote this improved framework. This type of competition serves as the active force that will compel the new firm to make its decisions in a different framework. In sum, both conditions will be necessary to improve the decision making framework that will lead to an improvement in the performance of the international communications industry.

Overall Comment

The structure of the international communications industry was significantly altered when Congress created the Communications Satellite Corporation. The ownership peculiarities of this firm and its role as the monopoly firm in international satellite communications, when juxtaposed against the prevailing interest of the existing international carriers in cable technology and their established dynamic markets, have presented the Commission with some rather significant problems. Within the limits established by Congress in the Satellite Act, the Commission has regulated Comsat with a series of policy decisions that restrict its function in providing communications services while attempting to monitor the performance of the international carriers on the basis of data and information available from the carriers.

The major solution to the problems in this industry may go beyond the present authority of the Commission and necessitate Congressional action of the type previously referred to, i.e., adapting merger legislation or amending the Satellite Act. In the meantime, the Commission must exercise the authority granted to it in the Communications

Act and the Satellite Act. At a minimum, this authority should be exercised to increase the information and data collected from the international carriers. Exercising its authority to obtain the kind of information previously referred to (e.g., detailed cost studies, etc.) will enable the Commission to increase the effectiveness of regulating the firms in this industry. Improved information will also enable the Commission to analyze and evaluate previous policies and investigate the potential effects of alternative courses of action that may be indicated in response to new developments and circumstances. In short, the Commission has the responsibility to regulate the international firms in an environment that was partially the result of a Congressional decision over which the Commission has no control. In the existing market structure the real drawback has been a lack of adequate detailed information. If the existing market structure continues then the Commission will be able to increase the effectiveness of regulation by expanding its information and thereby reducing the information gap that currently exists.

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APPENDIX A

CALCULATION OF ANNUAL ACCOUNTING COST ESTIMATES

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CALCULATION OF ANNUAL ACCOUNTING COST ESTIMATES

The purpose for Appendix A is to describe the data sources and methods used to estimate the annual accounting costs of the individual cables and satellite configurations. A number of reasonable estimated figures are used due to the international nature of the communication systems. For instance, foreign earth stations are not regulated by the FCC and, therefore, are not required to submit cost information to this agency. The same is true for cables since U.S. common carriers are only part owners. As a result, the data used are the best available figures and are drawn from a variety of sources. The final results are meant to be broad gauge estimates of costs and are most meaningful when interpreted in relative terms. The costs associated with the various cables are discussed first.

Cable Costs

The first step in estimating annual cable costs is to determine total investment costs associated with each facility. Each of the first three TAT cables has TASI equipment associated with it. The TASI equipment is a separate unit that can operate with any cable or be switched among cables. In practice, each piece of TASI equipment has been associated to a particular cable, and therefore, it is included in the cost of that cable. Initial investment costs for each cable were supplied by AT&T and are as follows:[1]

TAT-1	$44.9 million
TAT-2	42.0 million
TAT-3	46.4 million
TAT-4	46.0 million
TAT-5[2]	87.8 million

The major cost categories of the first four cables include land, buildings, central office equipment, cable, repeaters, radio, motor vehicles, furniture, fixtures, and work equipment.

It should be emphasized that the cost figures are estimated. AT&T and the record carriers own only a portion of each cable. In order to estimate the total investment cost AT&T has extrapolated its gross construction costs for

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[1]Letter dated July 31, 1970 from H. H. Joyner, General Manager, Ocean Cables, American Telephone and Telegraph Company to author.

[2]The original estimate of investment costs in the TAT-5 application was $70.4 million. This figure was subsequently revised in "Comments of American Telephone and Telegraph Company," FCC, Docket Number 18875. The MAT-1 cable is not included in the investment cost total. This cable extends across the Mediterranean Sea from Spain to Italy and is used in conjunction with TAT-5. However, MAT-1 is a completely separate cable that is not owned by AT&T. AT&T does have Indefeasible Right of User status on MAT-1.

each cable on the basis of its ownership percentage because it does not know precisely the capital costs incurred by the foreign correspondents.

The investment costs for the TASI equipment, also supplied by AT&T, including both terminals, are as follows:[3]

TASI-1	$5.1 million
TASI-2	3.0 million
TASI-3	2.3 million

The depreciation period for all equipment is 24 years and no salvage value is anticipated by AT&T. Applying straight line methodology, the annual depreciation expense is estimated. These expenses for the total cables and TASI equipment are as follows:

TAT-1	$1,871,000
TAT-2	1,750,000
TAT-3	1,933,000
TAT-4	1,917,000
TAT-5	3,658,300
TASI-1	213,000
TASI-2	125,000
TASI-3	97,000

The estimation of annual operation and maintenance expenses is computed on the basis of two procedures. The lower estimate is based on AT&T's portion of O and M. AT&T has stated that annual O and M averages about two

[3]H. H. Joyner, _op_. _cit_., p. 1.

percent of the original investment cost.[4] This estimate does not include the costs borne by the foreign correspondents who share the maintenance expenses. On the advice of AT&T, the two percent estimate is doubled to account for the foreign correspondents' shares. The O and M figures of AT&T consist of the following components: Wages of the terminal personnel, appropriate overhead, cost of maintenance, power, maintenance of building and grounds, motor vehicles, applicable cable maintenance, ship charges, and local and real estate taxes. Federal income taxes and depreciation charges are excluded.

The second method, resulting in higher figures, is based on a higher percentage. The percentage, 2.45 percent, is given in the Puerto Rico decision,[5] and was reportedly derived from actual experience by AT&T. As with the first estimating procedure an allowance must be made for the O and M expenses incurred by foreign owners to derive a total estimate. The estimate made with this higher percentage is doubled to account for the foreign correspondents' shares.

The annual maintenance charges for TASI under both procedures are $68,000 per terminal.[6]

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[4]Letter dated December 5, 1969 from H. H. Joyner to author, p. 2.

[5]ITT Cable and Radio, Inc.--Puerto Rico, et al., 5 FCC 2d (1966), p. 830.

[6]AT&T Comments, op. cit., Appendix 6, p. 10.

For TAT-5, in addition to the two estimation methods discussed, a third figure for O and M is presented. This figure is obtained from the TAT-5 application and is \$846,000.[7]

The total annual costs of the five TAT cables are summarized. Column 1 is based on two percent O and M; column 2 is based on 2.45 percent O and M; and column 3 is based on \$846,000 O and M for TAT-5.

TABLE 3.--Cable Cost Estimates.

Cable	(1)	(2)	(3)
TAT-1			
Depreciation	\$1,871,000	\$1,871,000	
O and M	1,796,000	2,200,000	
TASI-1			
Depreciation	213,000	213,000	
O and M	136,000	136,000	
Total	\$4,016,000	\$4,420,000	
TAT-2			
Depreciation	\$1,750,000	\$1,750,000	
O and M	1,680,000	2,058,000	
TASI-2			
Depreciation	125,000	125,000	
O and M	136,000	136,000	
Total	\$3,691,000	\$4,069,000	
TAT-3			
Depreciation	\$1,933,000	\$1,933,000	
O and M	1,856,000	2,274,000	

[7]American Telephone and Telegraph Company, Information supplied at the request of the FCC in the TAT-5 inquiry, October 30, 1967.

TABLE 3.--Continued.

Cable	(1)	(2)	(3)
TASI-3			
Depreciation	97,000	97,000	
O and M	136,000	136,000	
Total	$4,025,000	$4,440,000	
TAT-4			
Depreciation	$1,917,000	$1,917,000	
O and M	1,840,000	2,254,000	
Total	$3,757,000	$4,171,000	
TAT-5			
Depreciation	$3,658,000	$3,658,000	$3,658,300
O and M	3,512,000	4,302,000	846,000
Total	$7,170,000	$7,960,000	$4,504,300

Satellite Costs

There are a number of problems present in estimating annual satellite costs. The primary source of these problems pertains to data on foreign earth stations. Neither investment costs nor operating costs are reported to the FCC because the Commission does not regulate foreign interests. Nor is such information available through Comsat. As a result, estimated figures, as discussed below, are used.

Related to the data problem is the inability to determine the cost of additions to earth stations. As additional investments are made in foreign earth stations, annual depreciation expenses will be modified. Since yearly accounting information is not available these changes in investment cannot be determined. To the extent that changes have occurred, the allowance for depreciation is understated.

The O and M expenses for all earth stations are based on best available estimates. These estimates were obtained from Comsat's so-called "Gray Book"[8] and a number of studies performed by Comsat relating to foreign earth stations. Due to the uncertainty of the estimated O and M cost figures, a range has been calculated by adding and subtracting $100,000 per year to the original estimate. Thus, three estimates of total annual O and M are calculated for each earth station.

Two other O and M categories, system O and M and ground O and M, are associated with maintaining the satellites. For all satellites except the Intelsat IIIs, these two O and M figures are derived from the Gray Book estimates and allocated to individual satellites on the basis of the number in operation in a given year and the length of time in operation during the year. Satellite O and M for the Intelsat III generation is derived from Comsat information

[8] Revised Report on Rates and Revenue Requirements 1967-1971, Communications Satellite Corporation, November 10, 1966.

supplied to the FCC.[9] These amounts include the costs of tracking, telemetry and control (TT&C).

Another annual expense is depreciation and O and M of TT&C equipment associated with earth stations. In particular, the Andover earth station and the Fucino earth station which perform this function. Prior to 1969 separate figures for TT&C are not available. Therefore, TT&C is assumed to be included in the earth station estimates. Beginning in 1969, Intelsat assumed the TT&C costs (both depreciation and O and M). The costs can be identified and are included with the relevant earth stations.

Included in the annual costs associated with Intelsat II-F-3 and Intelsat III-F-2 is a portion of the "Program" costs for each of these satellite generations. These "Program" costs are relevant to the entire generation of satellites and are common to all satellites. They are depreciated by Comsat over the period the entire satellite generation is operational. This period is not coincident with the life of an individual satellite. These costs have been allocated evenly among the satellites and the period of depreciation has been adjusted to coincide with the life of the satellites.

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[9]Comments of Communications Satellite Corporation, FCC, Docket Number 18875, Table 5, p. 3.

Having reviewed the basic cost categories, it is now necessary to discuss the elements within these groups. The source of satellite investment costs, including launch costs, is information supplied to the FCC by Comsat. With the exception of Intelsat I, depreciation is on the basis of expected life. Intelsat I was originally anticipated to be operational for a period of 18 months. However, this satellite remained in operation for three and one-half years. Depreciation expenses are, therefore, spread over a 42 month period. The original investment costs for the appropriate satellites are as follows:

Intelsat I	$14,010,064
Intelsat II-F-3	6,849,281
Intelsat III-F-2	11,469,024
Intelsat III-F-6	11,497,000
Intelsat III-F-7	10,511,000

A majority of earth station investment cost estimates are the contract prices presented by Comsat.[10] There are some exceptions for earth stations that are not included in this list. For two of the original stations, Goonhilly-Downs and Fucino, estimates were not available. For the former station, the average investment cost of the first generation terminals is used. Fucino, on the other hand,

[10]Earth Station Price Analysis, Communications Satellite Corporation, Economic Analysis and Forecasting Department, April 23, 1968.

is designated as a non-standard station.[11] The estimate of its original cost is based on the estimate of a transportable earth station in Comsat's Gray Book and is substantially lower than the cost of the other stations.

Other earth station costs, added to the Atlantic Basin satellite system subsequent to the initial terminal configuration, are drawn from the Comsat source. Again, there are estimates for the original costs that are not available. Most notable are the terminals located on the Canary Islands and Ascension Island. The figures used for these two stations are the cost of a transportable station.

In a separate category are the U.S. earth stations at Andover, Etam, and Cayey. For the latter two, original cost data supplied to the FCC by Comsat are used. For Andover, the original contract price is used until its purchase from AT&T by Comsat in 1967. Thereafter, annual depreciation is based on actual accounting data, including periodic changes in costs that result from modifications to the station.

Annual depreciation expenses are based on an estimated eleven year composite life for the normal earth stations. With the exceptions noted for the U.S. earth stations, depreciation is 9 percent of original cost. The

[11] Inter-Office Memorandum, Communications Satellite Corporation, December 1, 1969.

estimated life of the transportable stations is seven years and depreciation is adjusted to reflect the shorter life.

The estimates for O and M of earth stations are drawn from Comsat sources. The only O and M cost figures associated with particular terminals are in a Comsat filing with the FCC.[12] These figures cover only U.S. earth stations and are appropriate in 1970 for the time period observed. For other stations and the remaining years, estimates are in two groups. For the original stations, except Fucino and Andover, annual O and M is estimated at $800,000 from Comsat's figure for a normal terminal.[13] Andover O and M is taken to be $1,200,000 while Fucino is $100,000. These figures include personnel, power, transmitter tube, heating, and building maintenance and repair. As mentioned, these basic estimates are used, plus and minus $100,000, to calculate two additional estimates of total annual O and M. The newer earth stations have slightly lower estimates for O and M. The figure $600,000 is used and is based on a number of cost studies for foreign earth stations performed by Comsat.[14] Again, the $600,000 is plus and minus $100,000.

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[12] Comsat Comments, op. cit., Item C, Table 5.

[13] Comsat Revised Report, op. cit., Section E, Exhibit E4.

[14] Examples of earth station studies prepared by Comsat are: "Cash Flow and Foreign Exchange Requirements Analysis of Two Earth Stations in Pakistan," August 25, 1967; "Breakeven Analysis of an Earth Station in the Republic of Korea," July 15, 1967; "Breakeven Analysis of an Earth Station in Central America," September 15, 1967; "Breakeven Analysis of an Earth Station in the Congo-Kinshasa," November 22, 1967.

The final problem is to match the earth stations with the appropriate satellite. Since the satellites change and new earth stations are installed the satellite and earth station configuration must be determined if the costs of a satellite system are to be estimated. Until 1967 only Intelsat I was operational so no problem in assigning earth stations existed. Subsequently, there were two satellites in operation. The configuration for two satellites and their earth stations is based on Intelsat Status Reports and Comsat's Reports to the President and Congress.

The costs estimated for 1970 are summarized in Table 4 as an example of the method used. Two satellites and associated earth stations were in service in 1970. Depreciation expenses and O and M are given for each satellite and its associated earth stations.

The same methodology is used in calculating total annual costs for the remaining years and satellite systems. The total annual costs obtained form the basis for the derivation of annual cost per circuit estimates for satellite and cable systems. The results are summarized in the accompanying Table 5. The estimates plotted in Figure 1 of Chapter IV are the low cost estimates in Table 5.

TABLE 4.--Satellite System Cost Estimates, 1970.

Intelsat	Low Estimate	Medium Estimate	High Estimate
Intelsat III-F-6	$ 3,292,000	$ 3,292,000	$ 3,292,000
Argentina	809,100	909,100	1,009,100
Buitrago #1	1,245,000	1,345,000	1,445,000
Cayey	1,097,000	1,197,000	1,297,000
Colombia	215,200	315,200	415,200
Etam	869,000	969,000	1,069,000
Fucino #1	1,516,000	1,616,000	1,716,000
Fucino - T,T&C	534,000	534,000	534,000
Longovilo	1,090,000	1,190,000	1,290,000
Peru	847,300	947,300	1,047,300
Mill Village #1	2,050,000	2,150,000	2,250,000
Pleumer-Bodou #1	1,687,000	1,787,000	1,887,000
Raisting #2	1,136,400	1,236,400	1,336,400
Tangua	845,500	945,500	1,045,500
Mexico	1,190,000	1,290,000	1,390,000
Utibe	790,900	890,900	990,900
	$19,214,400	$20,614,400	$22,014,400
Intelsat III-F-7	$ 2,069,000	$ 2,069,000	$ 2,069,000
Andover	1,978,000	2,078,000	2,178,000
Andover - TT&C	603,000	603,000	603,000
Lebanon	954,500	1,054,500	1,154,500
Iran	954,500	1,054,500	1,154,500
Ascension Island	271,000	371,000	471,000
Atlantic Ocean Ship	271,000	371,000	471,000
Goonhilly-Downs #2	1,136,400	1,236,400	1,336,400
Mill Village #2	903,600	1,003,600	1,103,600
Pleumer-Bodou #2	1,136,400	1,236,400	1,336,400
Morocco	954,500	1,054,500	1,154,500
Greece	863,700	963,700	1,063,700
	$12,095,600	$13,095,600	$14,095,600

TABLE 5.--Estimated Annual Costs per Circuit for Individual Facilities at Actual Usage Levels.

Facility	1965	1966	1967	1968	1969	1970
TAT-1 & TASI-1	45,700 50,300	45,700 50,300	45,700 50,300	45,700 50,300	45,700 50,300	45,700 50,300
TAT-2 & TASI-2	43,500 47,900	43,500 47,900	43,500 47,900	43,500 47,900	43,500 47,900	43,500 47,900
TAT-3 & TASI-3	22,700 25,000	22,700 25,000	22,700 25,000	22,700 25,000	22,700 25,000	22,700 25,000
TAT-4	40,400 44,900	30,600 24,000	28,100 31,200	27,300 30,300	27,300 30,300	27,300 30,300
TAT-5						15,300 24,400 27,100
Intelsat I	99,700 103,800 109,100	166,800 173,800 180,800	85,900 88,500 91,100	61,100 62,900 64,700		
Intelsat II-F-3			83,200 88,800 94,300	69,400 74,000 78,500	182,600 190,100 197,600	
Intelsat III-F-2					24,200 26,100 28,100	

TABLE 5.--Continued.

Facility	1965	1966	1967	1968	1969	1970
Intelsat III-F-6						26,400 28,300 30,200
Intelsat III-F-7						25,500 27,600 29,700

NOTE:

1. The number of circuits in service for each facility, by year, is as follows:

	1965	1966	1967	1968	1969	1970
TAT-1	88	88	88	88	88	88
TAT-2	85	85	85	85	85	85
TAT-3	178	178	178	178	178	178
TAT-4	93	123	134	138	138	138
TAT-5						294*
Intelsat I	75	86	151	220		
Intelsat II-F-3			72	154	41	
Intelsat III-F-2					892	
Intelsat III-F-6						728
Intelsat III-F-7						475

*This number is not an end of year total. The number is determined by examining the filings submitted to the FCC by the carriers in connection with the TAT-6 applications and Docket 18875.

It should be pointed out that the costs of satellite failures have not been included in the unit costs of the operational satellites. In the Intelsat III generation two Atlantic Basin satellites failed, the F-1 and the F-5. These two satellites are being depreciated at a rate of $2,367,000 per year and $2,225,000 per year respectively. If the cost of these failed satellites is allocated to the operational Atlantic Basin satellites, then adjustments to the estimated unit costs are necessary. To illustrate, in 1969 a full year of depreciation expense for Intelsat III-F-1 and approximately a half year of depreciation expense for Intelsat III-F-5 was incurred. If the total of these two depreciation expenses is added to the cost of the Intelsat III-F-2 the cost per circuit in service would increase by approximately $3,900. Similarly, in 1970 the same procedure would result in an increase of about $3,800 per circuit in service for both Intelsat III-F-6 and Intelsat III-F-7.

In 1970 the Intelsat III-F-2 was operated as an Atlantic Basin spare in orbit to protect against the possibility of failure of the other satellites. The depreciation and operating costs of this satellite are not included in the unit cost estimates of Intelsat III-F-6 and Intelsat III-F-7 for 1970. Making an allowance for this spare satellite, in a similar manner to the adjustments for the failed satellites, results in an increase of approximately

$3,000 per circuit in service for both Intelsat III-F-6 and Intelsat III-F-7.

Adding the adjustments for failed satellites and the in orbit spare results in an increase of $6,800 per circuit for both the Intelsat III-F-6 and Intelsat III-F-7 in 1970. In spite of these two adjustments the results do not significantly change the relationship of the two operational satellites relative to the cables in service at that time. The satellites are still significantly less costly than the TAT-1 and TAT-2. In comparison to TAT-3, the cost differential increases somewhat. With respect to TAT-4, the annual unit accounting costs of the two satellites are very comparable to the cable. The differential in use of capacity between the satellites and the TAT-3 and TAT-4 cables must be kept in mind when making these comparisons.

APPENDIX B

CALCULATION OF OUTPUT-INPUT INDICES

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The derivation of out-input indices for individual communication facilities consists of two basic steps. One is the assignment of output to the individual facilities. The second is to estimate capital input for each facility. The computation of capital input will be discussed first, followed by a description of the method used to assign output.

Capital Input

The first step in determining capital inputs is to revalue the facilities into base period prices, the base period being 1969. The various capital elements, cables, TASI equipment, satellites and earth stations, are originally valued in current prices according to the year of installation. To convert these current priced items into base period values two price indices are used. The Bell Telephone Plant Index is used to revalue each cable and the TASI equipment into base period prices. A similar index is not available for satellite equipment. In the absence of such an index the durable manufacturers index from the Bureau of Labor Statistics is substituted. The annual average of this index is used for the relevant years. Applying these indices to the cable, TASI equipment, satellites and earth stations adjusts the original cost upward into 1969 values.

The costs of the cables and TASI equipment in 1969 prices are as follows:

TAT-1	$57,157,700
TASI-1	6,262,800
TAT-2	51,534,000
TASI-2	3,681,000
TAT-3	56,747,200
TASI-3	2,757,700
TAT-4	55,154,000

Similar values for the satellites are as follows:

Intelsat I	$15,733,302
Intelsat II-F-3	8,542,096
Intelsat III-F-2	11,469,024

Since the Intelsat III-F-2 satellite is originally in 1969 value terms no adjustment is necessary. The same revaluation procedure is followed for each earth station where necessary, i.e., when not already expressed in terms of 1969 prices.

Since annual depreciation is necessary in order to determine net captial and capital input, this yearly expense item must also be revalued. The depreciation adjustments are calculated for each facility by applying the life of the facility to the adjusted original cost.

With the adjustments made in original cost and depreciation, it is possible to begin calculation of the annual capital input. Capital input is comprised of annual depreciation and return on capital elements. For a particular facility in a given year accumulated depreciation is determined. The value obtained for accumulated depreciation is then deducted from total cost in 1969 prices giving net capital. To determine that portion of capital input not contributed by depreciation, a rate of return must be calculated.

The rate of return for satellites and cables is computed for the 1969 base year. Ideally, the rate should be based on Atlantic traffic only. However, such a refinement of existing data is not available. As a proxy, the rates of return for AT&T and Comsat are computed as a percentage of total net capital. Using data presented in Moody's, net operating income, before taxes and interest payments but after depreciation, is computed.[1] The rate of return is calculated as the ratio of net operating income to net plant for each firm. On this basis the return for Comsat in 1969 is 4.7 percent while the rate for AT&T is 16.6 percent.

Capital input can now be determined. The return on capital is found by applying the rate of return to net capital in each year. Annual depreciation expense is added to the return on capital, the sum being capital input.

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[1]Moody's Public Utility Manual, August, 1969.

The values of the capital inputs for cables (including TASI) and the satellites over the 1966-1969 period are summarized in Table 6.

Output

Output estimates for the individual facilities are derived mainly from FCC Statistics for Common Carriers for the years 1966-1969. A number of estimating procedures and steps are involved.

The first step is to determine the countries reached by transatlantic facilities. AT&T traffic routing schedules are used for the purpose of identifying these countries. A number of countries are reached directly by cable and/or satellite circuits. In addition to direct circuits, there are a number of countries that are reached indirectly by going through the direct points. Numerous countries in Africa and the Near East are indirectly reached through transatlantic facilities. In addition, some countries in the Far East, e.g., India and Pakistan, have traffic routed through transatlantic facilities. It was necessary to assume that the routing of record carrier traffic was similar to that of AT&T because their routing schedules were not made available. Routing had to be traced for each year due to changes occurring as new facilities became available.

TABLE 6.--Capital Inputs, 1966-1969.

	1966	1967	1968	1969
TAT-1 & TASI-1	$ 8,978,700	$ 8,540,000	$ 8,101,300	$ 7,662,700
TAT-2 & TASI-2	8,835,400	8,287,500	8,071,600	7,619,700
TAT-3 & TASI-3	11,170,100	10,758,600	10,347,000	9,935,400
TAT-4	11,262,900	10,881,400	10,499,900	10,118,500
Intelsat I	12,574,800	11,813,800	12,168,300	
Intelsat II-F-3		4,603,500	8,790,300	
Intelsat III-F-2				17,026,500

The next step is to determine the total revenue attributable to message telephone, telegraph, and telex traffic. Since no changes in the basic telephone, telegraph, and telex rates occurred during the observed period, no adjustments are necessary to revalue output in terms of 1969 prices. Revenue figures, by country, are subdivided into traffic originating in the U.S. and traffic terminating in the U.S. Traffic transitting the U.S. is included in the latter category. The originating and terminating traffic is further divided into revenue and foreign payouts. However, the foreign payouts for terminating traffic are not included in the FCC Statistics. In order to derive a value for total revenue it is necessary to estimate the foreign payouts to each country for traffic terminating in the U.S. The assumption is made that the ratio of revenue to foreign payouts for the originating traffic is the same as the ratio for the terminating traffic. This assumption makes it possible to estimate the foreign payouts attributable to the terminating traffic. Total revenue for the three basic message categories of traffic for each country is the sum of these four revenue elements. Totalling the revenue figures thus obtained yields transatlantic revenue in the basic categories of message telephone, telegraph, and telex.

The total revenue figure must be allocated among the cables and satellites. The division between satellites and cables is based on the proportion of circuits used in each medium. FCC data indicate the number of cable circuits and the number of satellite circuits in operation by each record carrier.[2] Telegraph and telex revenue is allocated to the two mediums according to the circuit proportion. For instance, in 1968, of all transatlantic circuits, 81.6 percent were cable and 18.4 percent were satellite for the record carriers. Telex and telegraph revenue is allocated on the basis of these percentages in 1968.

The same procedure is employed to distribute message telephone revenue between satellites and cables. AT&T records show the number of cable and satellite circuits activated to each country. The ratio of cable to satellite circuits indicates the division of revenue. For example, in 1968, AT&T averaged about 123 cable circuits and 56 satellite circuits to the United Kingdom. The allocation is, thus, determined.

Next, the traffic from the three main categories is assigned to specific cables and satellites. The method used for this allocation is basically the same as the previous procedure. The number of circuits in service by each record carrier on each of the TAT cables is given in the FCC Statistics. The previously determined cable revenue is divided among the TAT cables on the basis of the proportion

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[2] FCC Statistics of Communications Common Carriers, 1966-1969, Table 31.

of circuits in service on each cable by the record carriers. In 1968, the operational circuits on the TAT cables by the record carriers was as follows:

TAT-1	12
TAT-2	9
TAT-3	40 4/22
TAT-4	60 15/22

Telex and telegraph revenue is allocated on the basis of these figures for 1968.

The revenue from message telephone traffic is divided on the same methodology. It is necessary to estimate the number of cable circuits devoted to message telephone traffic on each cable in each year because the information is not compiled in this manner. Periodic analyses are performed by AT&T showing a circuit breakdown on each cable by company, country, and AT&T circuits. These analyses are used to estimate the number of AT&T message telephone circuits and private line circuits. For 1967 the circuit breakdown for AT&T is as follows:

TAT-1	28	message	circuits	plus	37	TASI	circuits
TAT-2	37	"	"	"	"	"	"
TAT-3	73	"	"	"	"	"	"
TAT-4	73	"	"	"	"	"	"

Using these circuit totals, message telephone traffic is assigned to the TAT cables.

Private line revenue is estimated for each TAT cable. The methodology used to estimate these revenue totals for AT&T is explained. The number of private line circuits, by cable, is either given in AT&T data or estimated from this data.[3] The rate used to weight these private line circuits is the base period price and it is composed of two separate rates. One is AT&T's annual charge per leased voice-grade half circuit to Europe in 1969. The other is the counterpart set by the foreign correspondents for the remaining half circuit. With the number of private line circuits on each cable and the lease rate per circuit, total revenue can be computed.

For satellites, two additional sources of revenue must be assigned. One is the revenue from television transmission. TV revenue, by year, is available in the FCC Statistics. Television transmission time for each satellite is published by Intelsat.[4] The total television revenue is divided between satellites, when necessary, in proportion to the transmission time on each satellite. Since there was a 40 percent reduction in television rates in 1969, the base year, a downward adjustment in television revenue for the remaining years was necessary.

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[3]Data on private line circuits, by cable, for AT&T is given in "Response of AT&T to Letter of the FCC," October 4, 1967. Similar information on the number of private line circuits as of September 18, 1969 was supplied by AT&T to the author. This information is also given in "Comments of American Telephone and Telegraph Company," FCC, Docket Number 18875.

[4]Intelsat Status Report, International Telecommunications Satellite Consortium, April 23, 1969.

The second source of revenue specific to satellites is from NASA Communications. This revenue is on a lease arrangement for a specified number of circuits. The lease rate to NASCOM is a flat $480,500 for the satellite channels provided by Comsat.[5]

It must be recognized that revenue attributable to satellites from non-U.S. usage is not included in the satellite revenue totals. This information is not included in the FCC Statistics and is not available elsewhere. However, prior to 1968 there was no non-U.S. satellite traffic in the Atlantic area. In 1968 a small number of non-U.S. circuits were used and in 1969 this number began to increase as more foreign earth stations were installed. The effect of including non-U.S. revenue in the totals would be to increase output-input ratios because the earth stations are already included in the capital estimates.

The revenue, serving as a proxy of output, estimated for each form of communication is totalled for each communication facility used for each year in the observed period 1966-1969. These totals, by facility, are summarized in Table 7.

Having calculated the output and capital input of each facility over the 1966-1969 period, the output-input indices for individual facilities are the ratios presented

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[5] Revised Report on Rates and Revenue Requirements 1967-1971, Communications Satellite Corporation, Section B, p. 5.

TABLE 7.--Estimates of Output 1966-1969.

	1966	1967	1968	1969
TAT-1	$23,025,100	$23,570,100	$20,811,100	$ 21,906,800
TAT-2	23,185,900	22,763,700	21,199,300	19,598,400
TAT-3	57,522,500	57,710,500	49,338,200	49,267,000
TAT-4	53,645,500	62,310,900	54,711,600	52,913,200
Intelsat I	19,348,800	20,429,400	39,282,600	
Intelsat II-F-3		7,601,900	27,877,400	
Intelsat III-F-2				141,465,600[6]

[6]The significant increase in satellite output in 1969 is partially explained by the increase in earth stations. More specifically, traffic to Puerto Rico, Central America and South America is included for the full year. In 1968 the Puerto Rico earth station was not in commercial operation while the earth stations in Chile and Panama were not operational for the entire year. In 1969, these three earth stations became fully operational for the year and, therefore, traffic to these countries must be included in the satellite total. In addition, earth stations in Argentina, Peru, Brazil and Mexico commenced operation in 1969.

In 1969, Intelsat III-F-2 was out of operation during the month of July due to mechanical difficulties with the antenna. Service was restored in August. An adjustment has been made in the revenue total to account for this outage. The original revenue estimate has been reduced by 8.3 percent to allow for the month of outage.

in Table 1. Ratios are computed for gross and net output. Gross output figures are the values summarized above. Net output figures are the gross output values less annual depreciation expense. Both ratios are included to see if there is any difference in the results depending on whether or not output is net or gross.