Cables + satellites

Wednesday 6/23/71

11:10 Steve advises that the FCC yesterday determined not to authorize an SF cable -- they denied Tat-6. They do intend to invite the filing for an authorization for an SG. The Dept. of State transmitted the Commission's decision to all European posts last night. The carriers and Nick Zapple have been informed by the FCC.

Cable Sat

May 27, 1971

MEMORANDUM FOR DR. HENRY KISSINGER

As discussed in Mr. Whitehead's memorandum of 5 May, the Office of Telecommunications Policy has conducted a review of the policy issues connected with planning, construction, and operation of commercial international communications facilities. This review is now complete and the resulting conclusions and recommendations have been provided to the Federal Communications Commission. A copy of the policy statement is attached.

During the policy review we coordinated with Colonel Robert Behr of your office on an informal basis.

George F. Mansur

G. F. Mansur
Deputy

Atch.

G. F. Mansur/tw
RF
Subject File
W. Hinchman
CTWhitehead

Cable/Satellite

OFFICE OF TELECOMMUNICATIONS POLICY

WASHINGTON

May 25, 1971

Carl-

The attached policy paper which was forwarded to the FCC is virtually identical to the draft which we discussed last Friday. You will note that it does not oppose cables in a broad sense and, in fact, encourages development of both cable and satellite technologies. We believe this is in consonance with the spirit of Secretary Laird's recommendation to the Commission.

There is also evidence which cannot yet be made public that substantial and immediate rate reductions will be made by COMSAT in trans-Atlantic rates, if a new trans-Atlantic cable is not constructed at this time, so that existing facilities can be filled at a faster rate and thereby increase the utilization efficiency.

We are sure we have the same objectives in mind -- those objectives being the best service and reliability at lowest cost, both to DoD and to the general public, and believe that our views can converge with respect to the broad public policy issues.

Sincerely,

George F. Mansur

G. F. Mansur

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF TELECOMMUNICATIONS POLICY
WASHINGTON, D.C. 20504

DIRECTOR

May 25, 1971

MEMORANDUM FOR:

Honorable Melvin R. Laird
Secretary of Defense

As discussed in Mr. Whitehead's memorandum of 5 May, the Office of Telecommunications Policy has conducted a review of the policy issues connected with planning, construction, and operation of commercial international communications facilities. This review is now complete and the resulting conclusions and recommendations have been provided to the Chairman of the Federal Communications Commission. A copy of the correspondence is attached.

The fundamental premise of the Administration's policy is that the public interest is best served by permitting both cable and satellite technologies to evolve competitively in response to operational needs and economic considerations. We believe that adoption of this policy framework will provide industry, both domestic and foreign, with the guidance it needs to more effectively plan for new facilities.

We wish to express our thanks to the Department of Defense for their constructive advice and assistance during the course of the policy review.

G. F. Mansur

G. F. Mansur
Acting

Atch.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF TELECOMMUNICATIONS POLICY
WASHINGTON, D.C. 20504

DIRECTOR

May 21, 1971

Honorable Dean Burch
Chairman
Federal Communications Commission
Washington, D. C.

Dear Dean:

The planning, development, and operation of international communications facilities is a matter of major concern. There is rapidly growing public and commercial use of these facilities for telephone and telegraph traffic, television transmission, and other services. They are important to our businessmen, our news media, and our national security.

The present structure of the U. S. international communications industry creates the need for considerable governmental supervision over [illegible] investment in new facilities. In the past, this has resulted in close control of so many details of operation and construction that it is difficult to relate the regulatory controls to the overall public interest which they seek to promote.

I am enclosing the Administration's views on the policy that should guide regulation in this area. We believe that adoption of this policy framework will strengthen the ability of the Commission to assess the public interest in future investment decisions, and at the same time provide industry with the guidance it needs to plan efficiently and effectively. This policy relies on good faith and responsible action by our international carriers, which we believe will be forthcoming if the policy is firmly adopted. It leaves to the carriers, within appropriate limits, the freedom to use their judgment in those areas of operation and planning details where the Government lacks both the experience and the information to make the necessary decisions in a knowledgeable and timely way.

The policy further assumes that the Commission will determine when new capacity will be required sufficiently far in advance for orderly planning and approval of investment in new facilities.

Investment proposals should then be solicited and evaluated with a view to obtaining the required capability and reliability when needed at least cost. The U.S. international carriers strive to achieve the best in service through high reliability and conservative planning; our major concern from the standpoint of the public interest is that we avoid construction of excess capacity and deployment of inefficient technology.

Within reasonable limits set by the Commission, the carriers should be allowed to choose the type and timing of their new facilities. Those limits must, however, be sufficiently firm that the public interest is protected from investments which are excessively costly or otherwise seriously unsound. We believe this approach goes far to disentangle corporate and governmental decision-making to the benefit of both -- and especially to the ultimate benefit of the public.

Sincerely,

Tom

Clay T. Whitehead

Enclosure

Policy Recommendations and Conclusions for International Facilities

1. New facilities should be approved only when necessary to meet valid growth requirements, and only upon demonstration that they will result in the lowest additional cost* for comparable circuit capacity, reliability, and quality. These criteria should result in the lowest overall cost to the using public, since rate-regulated carriers are normally allowed to recover from their customers through their tariff offerings all investments and operating costs plus a rate of return on investment.

2. Tariff rates cannot be used as a valid public-interest criterion for approval of investments in new facilities, since they reflect the effects of past investment costs, rate-averaging, promotional pricing, and other deviations from true service costs. Only in the unusual circumstances in which two types of facilities are burdened identically by these factors do tariff rates provide a useful measure of the comparative costs of existing facilities, and clearly such rates cannot provide a measure of future costs.

3. Excess capacity or redundant facilities should be authorized to the extent reasonably necessary to make allowance for failure of facilities and to enable automatic restoration of interrupted service -- but not in excess of this requirement. Redundant facilities to enable automatic restoration should be required where this is the least-cost means of obtaining the overall continuity and reliability of service which is needed. This does not necessarily require duplication of circuits on different types of facilities, and such a fixed policy would be unnecessarily costly to the public.

4. Public policy does not require a particular ratio between satellite and undersea cable circuit capacity. Both modes may be needed to meet special service requirements and should be vigorously developed, but within broad limits the ratio should be allowed to evolve in response to operational needs and economic considerations.

---

*Based on present value of added investment and expected operating costs at relevant traffic (demands) levels. If the cost differential between alternative facilities is within the range of estimation uncertainty, the least-cost criteria should not be rigidly enforced.

Policy Recommendations and Conclusions for International Facilities

1. New facilities should be approved only when necessary to meet valid growth requirements, and only upon demonstration that they will result in the lowest additional cost* for comparable circuit capacity, reliability, and quality. These criteria should result in the lowest overall cost to the using public, since rate-regulated carriers are normally allowed to recover from their customers through their tariff offerings all investments and operating costs plus a rate of return on investment.

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MEETING
1/22/71
3:30 p.m.

Tuesday 1/12/71

5:15 We have scheduled the meeting on cables vs. satellites for 3:30 p.m. on Friday 1/22 -- for you and Dr. Mansur. We are inviting Bruce Owen, Seb Lasher and Charlie Joyce.

Walt Hinchman

Tuesday 1/19/71

MEEETING
1/20/71
3:30 p.m.

10:00 In order to include Mr. Scalia in the meeting, we have scheduled a meeting on cable policy for Wednesday (1/20) at 3:30 p.m. Those invited:

Dr. Mansur
Walt Hinchman
Bruce Owen
Mike McCrudden
Tony Scalia

Monday 1/25/71

MEETING
1/28/71
4:00

3:30 Mr. Joyce's office is setting up a meeting on cables vs. satellites. We have arranged it for 4:00 on Thursday (shifting the NAS meeting to Friday at 9:00).

Helen has invited Dr. Mansur, Col. Lahser, Dr. Owen, Mr. Hinchman, and Mr. Doyle.

Friday 1/22/71 MEETING
; Wk. of 1/25

2:00 Charlie Joyce asked if you really want this meeting at 3:30 this afternoon -- cables vs. satellites.

Lasher and Owen are meeting with some people on Tuesday. Thought maybe you would wish to postpone it until the middle of next week until there were further discussions with FCC and the carriers. Said he's finding ~~some~~ some interesting inputs. (Unless you have read it and have some things to say.)

3:15 Dr. Mansur and Mr. Whitehead agree to put the meeting off. Probably will be held middle of week of 1/25.

Cables &
Satellites

Monday 3/24/75

4:30 Dean Burch called Dr. Mansur in connection with cables and satellites. As a result of a Commission meeting held today, they have decided to "reconsider" the Tat-6 filing and that about mid-June they will allow comments by AT&T and Comsat on Tat-6, but in connection with the broader policy hearing. He stated that you are welcome to testify if you choose to do so, but that he will not issue a formal invitation. If you have any negative reaction to this proposition, Dean would like to know on Wednesday of this week (3/26).

cable + satellites

May 21, 1971

Honorable Dean Burch
Chairman
Federal Communications Commission
Washington, D. C.

Dear Dean:

The planning, development, and operation of international communications facilities is a matter of major concern. There is rapidly growing public and commercial use of these facilities for telephone and telegraph traffic, television transmission, and other services. They are important to our businessmen, our news media, and our national security.

The present structure of the U. S. international communications industry creates the need for considerable governmental supervision over its investment in new facilities. In the past, this has resulted in close control of so many details of operation and construction that it is difficult to relate the regulatory controls to the overall public interest which they seek to promote.

I am enclosing the Administration's views on the policy that should guide regulation in this area. We believe that adoption of this policy framework will strengthen the ability of the Commission to assess the public interest in future investment decisions, and at the same time provide industry with the guidance it needs to plan efficiently and effectively. This policy relies on good faith and responsible action by our international carriers, which we believe will be forthcoming if the policy is firmly adopted. It leaves to the carriers, within appropriate limits, the freedom to use their judgment in those areas of operation and planning details where the Government lacks both the experience and the information to make the necessary decisions in a knowledgeable and timely way.

The policy further assumes that the Commission will determine when new capacity will be required sufficiently far in advance for orderly planning and approval of investment in new facilities.

Investment proposals should then be solicited and evaluated with a view to obtaining the required capability and reliability when needed at least cost. The U.S. international carriers strive to achieve the best in service through high reliability and conservative planning; our major concern from the standpoint of the public interest is that we avoid construction of excess capacity and deployment of inefficient technology.

Within reasonable limits set by the Commission, the carriers should be allowed to choose the type and timing of their new facilities. Those limits must, however, be sufficiently firm that the public interest is protected from investments which are excessively costly or otherwise seriously unsound. We believe this approach goes far to disentangle corporate and governmental decision-making to the benefit of both -- and especially to the ultimate benefit of the public.

Sincerely,

Clay T. Whitehead

Clay T. Whitehead

Enclosure

cc: OTP Staff
Mr. Whitehead
Dr. Mansur
Mr. Ziegler
Mr. Strassburg (FCC)
Mr. Nick Zapple
Mr. Robert Guthrie
International carriers
Selected membersof the press
Mr. Flanigan

WHinchman/GMansur/CTWhitehead:jm/ed 5/20, 21/71

Policy Recommendations and Conclusions for International Facilities

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*Based on present value of added investment and expected operating costs at relevant traffic (demands) levels. If the cost differential between alternative facilities is within the range of estimation uncertainty, the least-cost criteria should not be rigidly enforced.

Enforcement of an arbitrary ratio will in general raise the overall cost to the using public and lessen the vigor with which industry pursues improvements in both technologies.

5. Cable and satellite circuits are comparable for most uses, and neither technology is inherently superior in a broad sense. Therefore, research and, where appropriate, development of both cable and satellite technology should be encouraged through competitive economic incentives not directly related to the successful deployment of a particular facility.

6. The rapid development of international direct distance dialing should be encouraged through improvements in the continuity and reliability of international transmission service.

7. The executive branch will inform the FCC of significant national security and foreign policy needs. The Government will continue to use commercial facilities to the maximum extent feasible and economic; however, specialized government circuit requirements do not provide a basis for approval of inefficient facilities, nor should they affect the mix of commercial facilities. Where there are too few circuits of any particular type for Government needs, the Government will construct or lease facilities rather than burden the using public by adding commercially inefficient facilities to the carriers' rate base.

8. An international working group of Government and industry representatives should be established to explore ways which would permit more flexibility in its investment and circuit activation decisions (e.g., redefinition of half circuits). This may alleviate much of the concern of our European communications partners, to whom the principle of proportional fill for cable and satellite facilities has been particularly annoying.

9. The planning and deployment of additional facilities for Atlantic basin communications in this decade should take into consideration the following conclusions, which are the product of a comprehensive review by this Office:

    -- Existing facilities plus those Intelsat IV satellites already authorized by the FCC provide sufficient capacity to meet the traffic projected by the industry through 1977, with sufficient reserves.

-- There is already in being adequate cable capacity to accommodate current and projected needs for high-priority national security communications and for specialized commercial services.

-- Current (SF) cable technology is several times more costly per circuit than current (Intelsat IV) satellite technology for high density transatlantic routes. The next generation (SG) cable appears comparable to Intelsat IV satellites in terms of cost and capability at relevant demand levels.

-- Satellite rates for transatlantic service can and should be reduced substantially in response to the lower cost Intelsat IV technology, provided that no new capacity is constructed in the next two years so that a reasonable fill rate can be maintained. Construction of additional cable capacity at the present time will be doubly costly to the public because of the higher costs of SF cable and the creation of excess capacity that will prevent early satellite rate reduction.

-- The most efficient means for achieving overall reliability of service adequate to support international direct distance dialing appears to be automatic restoration of interrupted satellite circuits on redundant satellite facilities.

Cables & Satellite

March 5, 1971

Mr. Leonard W. Tuft - WASHINGTON
Vice President ~~and General Attorney~~
RCA Global Communications, Inc.
1725 K Street, N. W.
Washington, D. C. 20036

Dear Mr. Tuft:

The Office of Telecommunications Policy is currently reviewing policy considerations involved in the planning and utilization of cables and satellites for international communications. As you know, these considerations include quality, reliability and economy of service; national security; international relations and institutions; and the vitality of the U. S. international communications industry.

While the parties involved have filed extensive comments with the Federal Communications Commission, we have been unable to obtain from these filings any clear comparison of the relative cost, reliability, and sufficiency of satellites and cables. Our staff has therefore developed an analysis using such data as is available from the filings and other sources. A preliminary draft of this analysis is enclosed. We are particularly interested in your candid evaluation of the methodology, data, and assumptions employed, as well as the results. Where you can provide improved data or insight, this would be most welcome. To the extent you may desire, this will be treated as privileged information -- as is our draft analysis.

As noted, these considerations are but a few of many factors involved in these decisions -- though they are very important. We are also examining the other issues noted, and would welcome any further information or views (beyond those contained in your FCC filings) you wish to provide.

Your early response to the attached paper would be appreciated. If possible, we would hope to have all comments by March 19, 1971.

Sincerely,

SIGNED

Walter R. Hinchman

WRHINCHMAN:dc
Mr. Whitehead
Hinchman:Subj:Cables/Satellites
RF
Col. Lasher

Encl.

cc: Gene Murphy
VP & Gen Counsel - N.Y.

March 5, 1971

Mr. Lucius D. Battle
Vice President
Corporate Relations
Communications Satellite Corporation
950 L'Enfant Plaza South, S. W.
Washington, D. C. 20024

Dear Mr. Battle:

The Office of Telecommunications Policy is currently reviewing policy considerations involved in the planning and utilization of cables and satellites for international communications. As you know, these considerations include quality, reliability and economy of service; national security; international relations and institutions; and the vitality of the U. S. international communications industry.

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Sincerely,

Walter R. Hinchman

WRHINCHMAN:dc
Mr. Whitehead
Hinchman: Subj:
Cables/Satellites
RF
Col. Lasher

March 5, 1971

Mr. Edward B. Crosland
Vice President, Federal Relations
American Telephone & Telegraph Company
2000 L Street, N. W.
Washington, D. C. 20036

Dear Mr. Crosland:

The Office of Telecommunications Policy is currently reviewing policy considerations involved in the planning and utilization of cables and satellites for international communications. As you know, these considerations include quality, reliability and economy of service; national security; international relations and institutions; and the vitality of the U. S. international communications industry.

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Walter R. Hinchman

WRHINCHMAN:dc
Mr. Whitehead -2
Hinchman:Subj:Cables/Satelities
RF
Col. Lasher

March 5, 1971

Mr. Henry G. Catucci
Vice President
Western Union International, Inc.
2100 M Street, N. W.
Washington, D. C. 20037

Dear Mr. Catucci:

The Office of Telecommunications Policy is currently reviewing policy considerations involved in the planning and utilization of cables and satellites for international communications. As you know, these considerations include quality, reliability and economy of service; national security; international relations and institutions; and the vitality of the U. S. international communications industry.

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Sincerely,

SIGNED

Walter R. Hinchman

WRHINCHMAN:dc
Mr. Whitehad
Hinchman:Subj: Cables/Satellites
RF
Col Lasher

March 5, 1971

Mr. Joseph J. Gancie
Vice President & Director of
Government Relations
ITT World Communications
1707 L Street, N. W.
Washington, D. C. 20036

Dear Mr. Gancie:

The Office of Telecommunications Policy is currently reviewing policy considerations involved in the planning and utilization of cables and satellites for international communications. As you know, these considerations include quality, reliability and economy of service; national security; international relations and institutions; and the vitality of the U. S. international communications industry.

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Sincerely,
SIGNED

Walter R. Hinchman

WRHINCHMAN:
Mr. Whitehead
Subj: Cables/Satellites
RF
Col Lasher
Encl.

March 5, 1971

Staff Analysis on Satellite/Cable Mix

Mr. Tom Nelson
Department of State

Enclosed is a draft copy of an OTP staff analysis dealing with the relative cost, reliability, and sufficiency of international satellite and cable facilities. Copies have also been sent to the principal international carriers (AT&T, COMSAT, WUI, RCA, ITT) and interested government agencies.

We have asked the carriers for candid comments regarding the methodology, data, and results contained in this analysis. We are of course examining other, less quantifiable aspects of this question and will stay in touch as our analysis progresses.

SIGNED

Walter R. Hinchman

Encl.

WRHINCHMAN:dc
Mr. Whitehead
Subj: Cable/Satellite
RF
Col Lasher

March 5, 1971

Staff Analysis on Satellite/Cable Mix

Mr. Don Baker
Department of Justice

Enclosed is a draft copy of an OTP staff analysis dealing with the relative cost, reliability, and sufficiency of international satellite and cable facilities. Copies have also been sent to the principal international carriers (AT&T, COMSAT, WUI, RCA, ITT) and interested government agencies.

We have asked the carriers for candid comments regarding the methodology, data, and results contained in this analysis. We are of course examining other, less quantifiable aspects of this question and will stay in touch as our analysis progresses.

I would appreciate your treating this as privileged information -- not for distribution or reproduction.

SIGNED

Walter R. Hinchman

Encl.

WRHINCHMAN:dc
Mr. Whitehead
Subj: Cable/Satellites
RF
Col Lasher

March 5, 1971

Staff Analysis on Satellite/Cable Mix

Mr. Robert O'Mahoney
General Services Administration

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SIGNED

Walter R. Hinchman

Encl.

WHINCHMAN:dc
Mr. Whitehead
Subj: Cable/Satellites
RF
Col Lasher

March 5, 1971

Staff Analysis on Satellite/Cable Mix

Mr. Bernard Strassburg
Federal Communications Commission

Enclosed are three draft copies of our staff analysis dealing with the relative cost, reliability, and sufficiency of international satellite and cable facilities. Copies have been sent to the principal international carriers (AT&T, COMSAT, WUI, RCA, ITT) and interested government agencies for review and comment by March 19.

We are looking forward to a good discussion of these analyses at our Monday meeting. As noted in our letter to the carriers, we are interested in candid comments regarding the methodology, data, and results contained in the analysis.

SIGNED

Walter R. Hinchman

Encls.

WRHINCHMAN:dc
Mr. Whitehead
Hinchman: Subj: Cable/Satellites
RF:
Col Lasher

March 5, 1971

Staff Analysis on Satellite/Cable Mix

Mr. Ken Goodwin
FCC Planning Staff

Enclosed are ten draft copies of an OTP staff analysis dealing with the relative cost, reliability, and sufficiency of international satellite and cable facilities. Would you distribute them to Chairman Burch and the Commissioners for information?

Copies of this analysis are being sent to the principal international carriers (AT&T, COMSAT, WUI, RCA, ITT) and interested government agencies for evaluation and comment. We expect replies by March 19, following which we will provide a final analysis of these and other considerations regarding satellite/cable mix in international communications.

SIGNED

Walter R. Hinchman

WRHINCHMAN:dc
Mr. Whitehead
Hinchman: Subj: Satellite/Cable
RF
Col Lasher

TO Dr. Whitehead
FROM H. G. CATUCCI, VICE PRESIDENT
WUI INC. WASHINGTON, D. C.

Cables v. satellite

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

In the Matter of	)	
	)	
Inquiry into policy to be followed in future licensing of facilities for overseas communications.	)	Docket No. 18875

COMMENTS OF WESTERN UNION INTERNATIONAL, INC.

Robert E. Conn
Ernest Brod
Alexander D. van Eyck

26 Broadway
New York, New York 10004

Attorneys

September 14, 1970

Mr Hinchman has original

Cable Vs Satellite

Satellites and Cables

3/5 Send out economic/reliability paper for comment -- Walt

- (a) Carrier
- (b) Executive branch
- (c) Strassburg

3/26 Review and extend analysis

3/29 Letter to FCC

- (a) No capacity immediately
- (b) Mix is economical; __________ rather than ratio
- (c) SF out; SG maybe, but not until capacity needed
- (d) National security needs for cable must be met, but already met.

Enclosures -- analysis and classifed not see statement

Cables + satellites

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF TELECOMMUNICATIONS POLICY
WASHINGTON, D.C. 20504

OFFICE OF THE DIRECTOR

March 1, 1971

TO: Walt

FROM: George

In our proposed policy memo to FCC on cables and satellites, should we also consider commenting on the validity of 24-year straight line depreciation of cable assets, in view of the "technological life" of cables? If so, should we develop data to support our comments?

cc: Mr. Whitehead ✓
Dr. Owen
LtCol Lasher

cable vs satellite

February 17, 1971

MEMO FOR: Mr. Hinchman
Mr. Owen
cc: Mr. Whitehead
Dr. Mansur

From: J. M. Thornell

Subject: Recommendations for Cable/Satellite Scenarios

When considering all the possible scenarios that could be prepared, evaluated, and sent forward to the carriers for comment, the possibilities become voluminous. Therefore, it is recommended that the scenarios sent forward be constructed to basically answer the following questions:

(1) If compared on a short term (7 years) basis in a point-to-point configuration, are satellite systems of INTELSAT IV capacity more or less expensive to install, maintain, and operate then either SF or SG type cables?

(2) When compared on the long term (24 years), are satellites or cables most economical in a point-to-point configuration?

(3) When compared on the "most likely" mode of operation in the long term with cables being a point-to-point system and satellites being a multi-point system, and including the cost of back-haul circuits of the major switching centers, do satellites or cables offer the most economical approach?

In constructing the three scenarios, the following general rules should be imposed to insure a valid comparison:

(1) The circuit availability for both cable and satellite systems should be equal and approximately 99.5%.

(2) All maintenance and repair cost of the cables should be included.

(3) Satellite systems should include in-orbit spares.

(4) The capacity demand growth pattern must dictate the system design capacity.

(5) Any new research and development that occurs during an evaluation period should be included in the system cost.

(6) Cables should be evaluated on a 24 year life cycle and satellites on a 7 year cycle with prorations as required for the evaluation period considered. When additional cables or supplementary satellites are required during an evaluation period, only those pro-rata fixed cost applicable for the initial evaluation period should be included.

(7) For the "most likely" operating mode evaluation, it should be assumed that both the satellite and cable circuits terminate in six or seven major switching centers in northern Europe and that existing technology for terrestrial communications is used for this connection.

(8) All cost that are likely to be used in determination of a basic rate structure should be included and "sunk" cost are not valid for exclusion.

If these scenarios are prepared, evaluated, and sent forward to the carriers for comment, I think that the basic questions upon which this Office must make any policy decision will be answered.

Cost/reliability combination
Cable reliability comparison.

INTERNATIONAL TELECOMMUNICATIONS FACILITIES IN THE DECADE OF THE SEVENTIES

ANALYSIS OF DATA AND POLICY OPTIONS AVAILABLE
TO THE
OFFICE OF TELECOMMUNICATIONS POLICY

Sebastian Lasher
Bruce Owen

January 1971

CONTENTS

INTRODUCTION

In the analysis presented here, we have attempted to compare the merits of cables and satellites in meeting the demands for new trans-oceanic telecommunication facilities in the coming decade.

Lacking really adequate data, we have at many points been forced to rely on estimates and approximations. In doing so, we have been guided by the principle that such assumptions should be made on a basis which does not favor the outcome which, _a priori_, seems most probable.

It is particularly unfortunate that the responses of the carriers to the Notice of Inquiry in Docket 18875 do not supply information which is either complete or even relevant to the kind of analysis which is presented here. Both COMSAT and AT&T have voluntarily supplied us with some supplementary data for use in this analysis, at our request.

We have not considered here any of the problems associated with the continued existence of the international record carriers.

In the sections which follow, we deal with cost comparisons, reliability characteristics, national security requirements, political considerations, and policy options.

COST ANALYSIS

This section has two parts. In the first, we consider a somewhat abstract cost model of the two technologies in an effort to discover which of the two is more efficient. The second part is an examination of the revenue requirements per circuit (or the implied tariffs) of alternative policy strategies. The two approaches are conceptually distinct in the sense that revenue requirements are calculated on the basis of well-known accounting procedures which are, with respect to the basic economics involved, rather arbitrary. The cost analysis in the first part is concerned with the value of resources committed by alternative investment strategies, and ignores, for instance, sunk costs. The revenue requirement approach takes into account the need to recover sunk capital costs, but ignores the value of resources committed in the future by present decisions. The revenue requirement approach is relevant to decision making only to the extent that it is used in practice to determine actual tariff rates.

Comparative Cost Model: Conclusions

Satellites and cables have fundamentally different characteristics, and a "fair" cost comparison is thus very difficult. Since we suspect at the outset that most people believe satellites to have a cost advantage, we deliberately choose to employ a set of assumptions which is favorable to cables. In this way, we hope to derive a cost comparison which yields necessary or sufficient conditions for the opposite result--cables cheaper than satellites.

We were able to derive sufficient (but not necessary) conditions for cables of the SG type to be less expensive than satellites. These conditions are stated in Table 1. We believe that these conditions have a fairly low probability of being realized, and therefore conclude that cables are not in fact less expensive than satellites. However, the probability that these conditions will in fact obtain is not zero, and the necessary conditions involved are presumably less extreme. Therefore, the range of possible satellite costs overlaps the range of projected cable costs.

The cost of obtaining additional capacity on existing facilities by means of compression techniques which are not more expensive than TASI-B is on any reasonable set of assumptions considerably less than either additional cable capacity or additional satellite capacity. The marginal cost of circuits derived by TASI-B is shown in Table 6; in addition to TASI-B, there exist other compression techniques, but we have no data on their cost.

There do exist routes and circuit demand conditions for which cables are less expensive than satellites on a point-to-point comparison basis (see Table 5). However, when the global coverage characteristics of satellite technology (which permit many routes to share a single satellite) are considered, even these routes and traffic conditions would in some cases be most cheaply satisfied by satellite capacity.

Cost Model: Description

Cables last 24 years, while satellites last for only a fraction of that time. To compare the two properly, we assumed that it would be necessary to replace satellites as they died in order to obtain a system life of 24 years for both media. The INTELSAT III series have to be replaced at five year intervals, while the INTELSAT IV "birds" last seven years. The initial investment cost used for satellite systems thus includes the discounted value of the replacement costs necessary to maintain a satellite in orbit for 24 years. For this and all other purposes, we use a discount rate of 10%.

For both cable and satellite systems, the cost basis is assumed to be full investment cost plus operating cost and profit over the full 24-year period, appropriately discounted. These calculations are summarized or illustrated in Tables 2, 3 and 4 and the footnotes thereto.

Since cables serve only two points, while satellites serve many points, it was necessary to choose between a point-to-point system comparison and a global system comparison. The former is chosen since it seems likely to be more favorable to cables. We ignore the costs associated with transmission of traffic beyond the cable head to interior points which could be served directly by earth stations. Point-to-point satellite systems do have the advantage of providing higher circuit capacity than global beam systems, and the point-to-point comparison is to this extent favorable to satellites.

The basic units of comparison are thus a 24-year cable and a satellite system consisting of one dedicated bird and two earth stations, lasting 24 years through appropriate replacement.

The analysis is sensitive to assumptions about launch failure and satellite redundancy. A "high" failure rate of one in two launches and a "low" rate of one in four are illustrated in Table 4, along with "high" and "low" reliability modes. The "high" reliability mode simply consists of duplicate satellite systems serving the same route and traffic.

The costs of the alternative technologies on the basis of this comparison model are illustrated in Figure 1, for an Atlantic route. Figure 1 could be supplied with a third dimension--route length--in which cable costs per circuit would vary with distance while satellite costs remain constant.

Figure 2 shows the relationship between cost and distance for the several technologies. The extrapolated negative intercept for SF cable technology suggests that the cost data provided by AT&T for this cable may be understated.

The "high failure, low reliability" satellite mode is used for both Figure 1 and Figure 2. We believe that this is a reasonably conservative basis of comparison, but it is not the most expensive of the satellite alternatives.

By 1980, we are projected to need about 5600 additional transatlantic circuits. The cost of providing 5600 24-year circuits by various technologies is summarized as follows:

	Cost Per 24-Yr Atlantic Circuit
SF Cable	$275,000
SG Cable	90,000
III HF LR 1/	140,000
IV HF LR 2/	55,000
TASI-B 3/	75,000

1/ INTELSAT III, high failure, low reliability.

2/ INTELSAT IV, high failure, low reliability.

3/ This is the average cost of circuits created by TASI-B, not counting the cost of the initial basic facility. TASI-B costs are derived from AT&T sources, and it is likely that high utilization of such techniques would reduce the stated cost.

It should be noted that several SF cables are required to satisfy this requirement, whereas one INTELSAT IV is not filled with 5600 circuits.

Summary of Cost Model

It is possible, but unlikely, that cable technology of the SG type is less expensive than satellite technology on Atlantic routes. SF cable technology is clearly the most expensive of any of the available options.

We have already committed more than $100 million in resources for the first four flights of the INTELSAT IV series. If these flights do not fail, they will provide sufficient capacity to satisfy demand at least through 1975. A TAT-6 utilizing SF technology is required only in the event that a 50-50 split is desirable.

TABLE 1

The following set of assumptions is sufficient to make cables (SG type) dominate satellites on a 3500 mile (Atlantic) route up to 7000 circuits. Beyond 7000 circuits, INTELSAT IV dominates up to 8500 circuits, then three SG cables are again superior beyond 8500 circuits.

1. Failure rate of 1 launch in 2.

2. 100% satellite system redundancy.

3. 24-year system life for satellites.

4. Acceptance of AT&T cost data for cables without allocation of administrative expense.

5. Very conservative allocation of satellite costs.

6. Neglect of transit charges for traffic to countries which do not have cable heads.

TABLE 2

Cost Analysis: Proposed Cables, 1970 - 1980

	Cable	Circuits	Miles (naut)	Total Cost (millions)*	Cost per ckt mile	Ckt. miles (000)	Type
1.	Bahamas	1840	300	$ 23.0	$ 41.67	552	Brit.
2.	St. Thomas	640	545	59.8	171.44	349	Brit. **
3.	PR # 2	1840	1185	89.6	41.09	2180	Brit.
4.	St. Thomas # 3	3500	1185	111.2	26.81	4148	SG
5.	TAT 6	825	3500	220.8	76.47	2888	SF
6.	TAT 7	3500	3300	244.8	21.19	11550	SG
7.	TAT 8	3500	3300	245.1	21.22	11550	SG
8.	Haw # 3	825	2383	138.8	70.50	1970	SF
9.	Guam +	825	5000	293.0	71.00	4120	SF
10.	Haw # 4	3500	2200	176.9	21.20	8350	SG

* Cost is based on AT&T 18875 filing as follows: Total Cost equals investment cost plus allocated development cost plus discounted value (to year of installation) of operating expense, profit, and taxes over 24 year life of each cable. Discount rate of 10% used to reduce future expenses. No administrative costs were allocated. Profit included in AT&T reported O&M figures.

** This cable is an anomoly and is not further considered.

TABLE 3

Satellite Cost Analysis: Conservative Basis [1/]

The alternative to one cable considered here is one fully dedicated satellite system for the route in question. A "system" is one bird plus two ground stations. To be comparable to cables, it is assumed that the bird is replaced sufficiently often to keep the circuits available for 24 years.

INTELSAT III has a five-year life, and each bird costs $12 million.

INTELSAT IV has a seven-year life, and each bird costs $29 million.

INTELSAT III has 1500 circuits, INTELSAT IV has 8500.

A failure rate of one in two is assumed. This doubles the cost of each bird in orbit.

A discount factor of 10% is used to reduce investment and operating flows to present value in first year of program.

Cost Item	INTELSAT III (millions of dollars)	INTELSAT IV (millions of dollars)
Satellites (24 years)	57.6	111
Allocated R&D	1.0	1
Two earth stations @ $5m	10.0	10
Profit @ 24% of ave. investment [2/]	79.2	157
O&M--satellite @ $1.2m/yr.	11.3	11
O&M--stations @ $1.5m/yr.	14.1	14
Administration--@ $3m/yr.	28.0	28
Total discounted value of resources committed in initial year	191.2	322

1/ "Low" reliability.

2/ Average investment equals cost of two earth stations plus allocated R&D plus cost of two birds.

TABLE 4

SATELLITE COST ANALYSIS

	Total Cost (millions)		Cost per Available 24-Year Circuit (000)	
High Reliability	INTELSAT III	INTELSAT IV	INTELSAT III	INTELSAT IV
High Failure Rate	$ 382	$ 644	$ 254	$ 76
Low Failure Rate	346	508	230	60
Low Reliability				
High Failure Rate	191	322	127	38
Low Failure Rate	173	254	115	30

High Reliability = 100% redundancy in satellites, ground stations, admin. expense.

Low Reliability = One bird in orbit plus two ground stations plus associated profit and operational expense.

Low failure rate = 3 successful launches in 4.

High failure rate = 1 successful launch in 2.

Costs in all cases are on a 24-year basis, discounted to initial value at 10%.

TABLE 5

LEAST COST STRATEGIES

Route Length	Circuit Demand of Less than: 825	1500	3500
0 - 3000 miles	SF cable		
3000 + miles	INTELSAT III		
0 - 2200 miles		British	
2200 - 2400		SG cable	
2400 +		INT. III	
0 - 4500 miles			SG cable
4500 +			INTELSAT IV

Circuit Demand	Route Length (miles): 1185	2400	3500
0 - 1800 ckts.	British		
1800 - 3500	SG cable		
3500 +	INTELSAT IV		
0 - 825 ckts.		SF cable	
825 - 3500		SG cable	
3500 +		INTELSAT IV	
0 - 1500 ckts.			INTELSAT III
1500 - 3500			SG cable
3500 +			INTELSAT IV

TABLE 6

TASI-B COSTS (24-year basis)

Two TASI-B terminals are required to obtain 237 circuits from 100 circuits. Each terminal costs $2 million. O&M is about $50,000 per year per terminal.

Present Value

Investment	$ 4.0 million
Profit @ 14%	5.3
O&M	0.9
Total	$10.2

The marginal (above cable) cost of an average TASI-B circuit is thus about $75,000 on a 24-year basis.

FIGURE 1

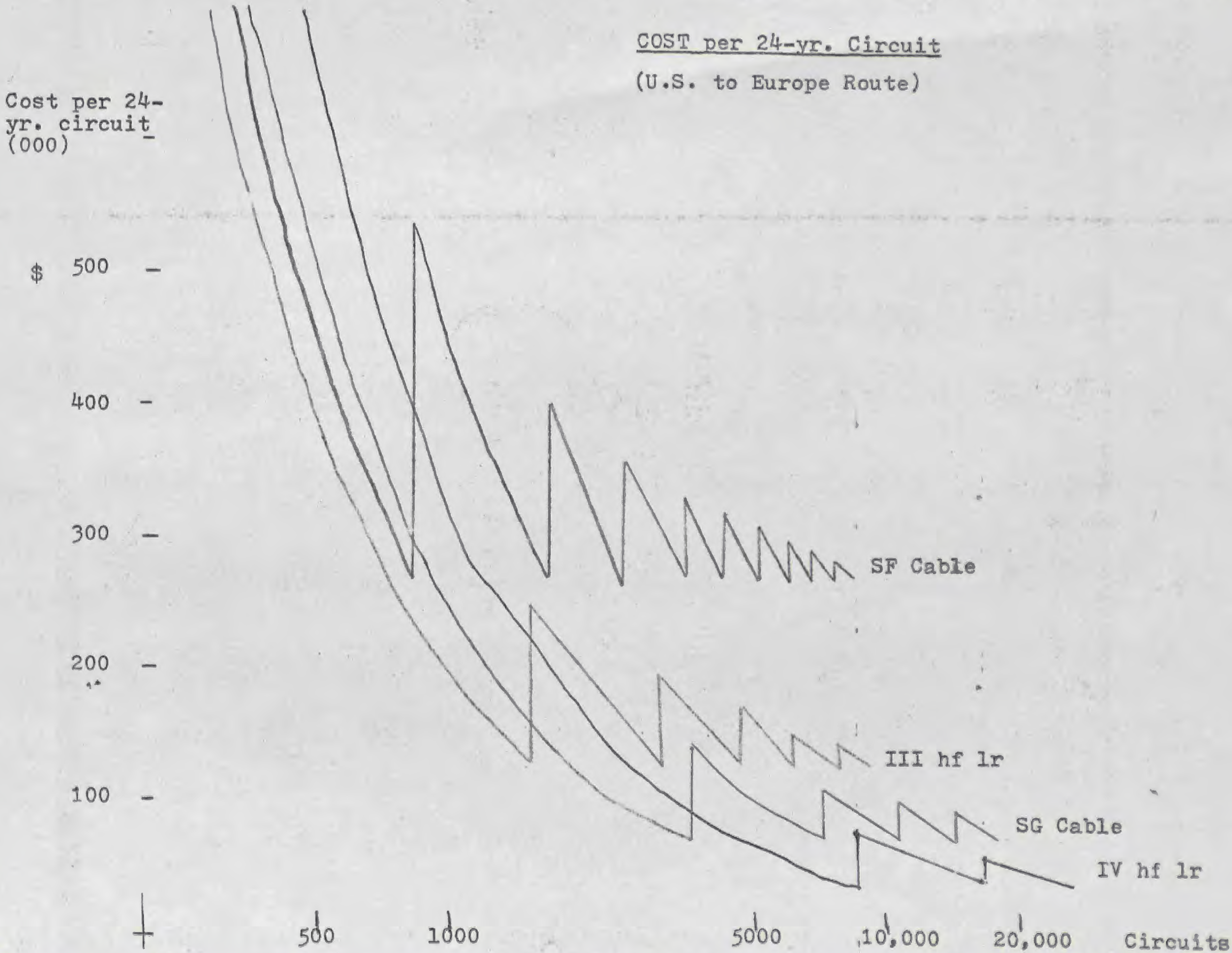
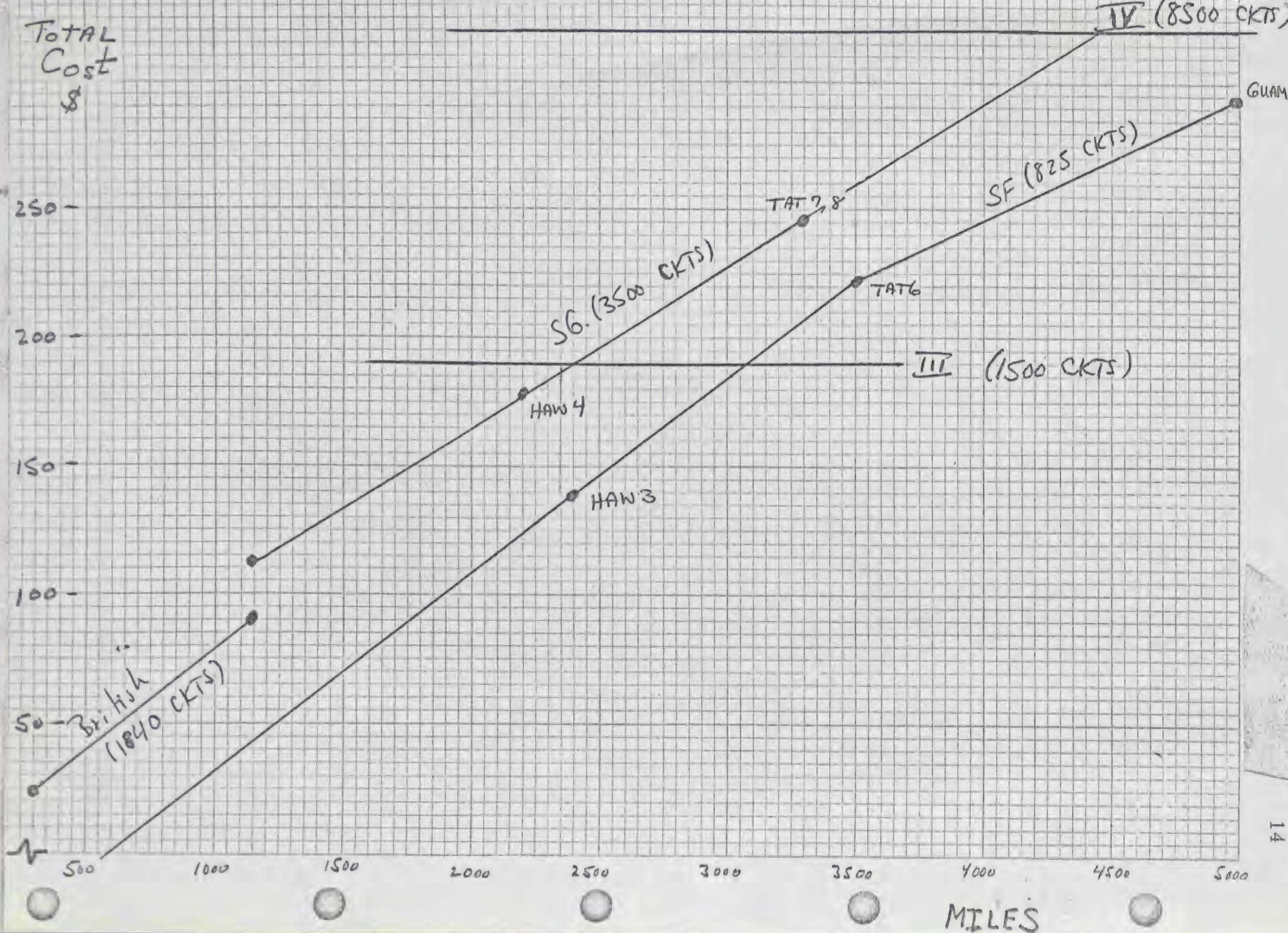

COST per 24-yr. Circuit
(U.S. to Europe Route)
Cost per 24-yr. circuit (000)
$ 500
400
300
200
100
500
1000
5000
10,000
20,000
Circuits
SF Cable
III hf lr
SG Cable
IV hf lr

FIGURE 2



TOTAL
Cost
$
250
200
150
100
50
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
MILES
IV (8500 CKTS)
GUAM
SF (825 CKTS)
TAT 7 8
TAT6
S6. (3500 CKTS)
III (1500 CKTS)
HAW 4
HAW 3
British
(1840 CKTS)

Revenue Requirements and Tariffs

The cost comparisons above are not directly related to the actual revenue requirements and tariffs which could result from alternative investment strategies. We have calculated revenue requirements for COMSAT and for AT&T's cables based on alternative strategies: A 50-50 split of traffic in the Atlantic, satisfaction of new demand entirely by cable, and satisfaction of new demand entirely by satellite. The results are given in Figure 3, the notes thereto, and Table 7.

The assumptions underlying Figure 3 are basically those of COMSAT's filing in Docket 18875, extended through 1980. The assumptions underlying Table 7 for cable revenue requirements are derived from AT&T's filing.

The principal conclusion here is that the terms of a 50-50 split leave satellites with so much unutilized capacity that the satellite revenue requirements are not much different than the cable requirements. If composite rates are charged to the customer by AT&T operating under the authorized user decision, the advantage to the public from satellite technology is vitiated.

Price competition between the two media would, absent service quality differentials, lead to COMSAT's dominance on Atlantic routes, and would lead to substantial price reductions to the public.

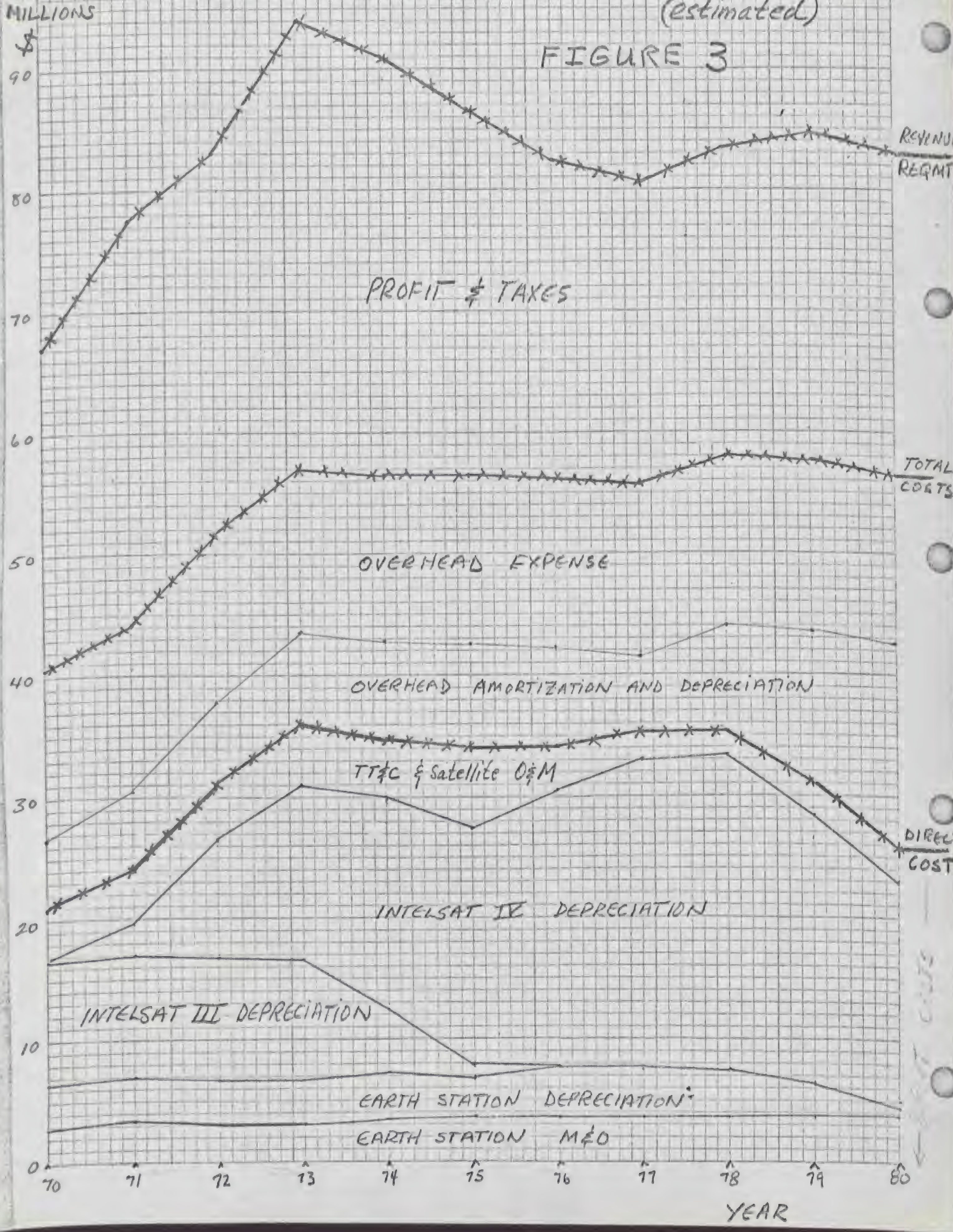
Cost Analysis: Summary

Both the cost model and the revenue requirement approach strongly suggest that satellites are the cheaper technology, provided they are able to achieve reasonably high utilization rates. A 50-50 split of traffic does not achieve sufficiently high utilization of satellite capacity to give satellites a significant price advantage over cables.

Competition between cables and satellites in price and service, with no restrictions on output or investment, would appear to have substantial potential benefits for the public.

COMSAT REVENUE REQUIREMENTS
(estimated)

FIGURE 3



Notes to Figure 3

COMSAT REVENUE REQUIREMENTS

Direct Costs

From Table 5, item C of COMSAT filing in 18875 and data furnished separately by COMSAT on flight 9-15 for INTELSAT IV and TT&C costs.

Earth Station = 50% $\sum$ M & O + Δ depreciated value + Δ investment.

INTELSAT III and IV + 53% $\sum$ M&O + Δ depreciated value.

Overhead

From COMSAT Annual Report for 1969 and data furnished separately by COMSAT on depreciation.

Amortization and depreciation includes:

a) $18.4 million net Satellite System Development Cost at year end 1969 which is amortized through year end 1976.

b) $8.2 million net capitalized R&D at year end 1969 with additional R&D investments of $4.8M in 1970, $1M/yr in 1971 through 1975, $10M in 1976 and 1977 and $20M/yr in 1978 and 1979.

c) $22.4 million net investment in HQ's and laboratory at year end 1969 with additional investments of $2M/yr throughout the period except in 1977 which is $12M to reflect exercising an option to buy the headquarters building and replacement of computer. Expenses reflect the difference between the M&O charges under "direct costs" above and those reported in the 1969 Annual Report. It is assumed that this will be an annual recurring expense.

$ 42.4M	Net operating expense, 1969 Annual Report
- 17.5M	Depreciation and Amortization, 1969 Annual Report
24.9M	
- 11.3M	Total direct M&O in 1970 per Table 5, item C filing
$13.6M/yr	Indirect operating expense annual.

Notes to Figure 3 (Continued)

Profit and Taxes

No rate base definition has been agreed between the FCC and COMSAT. An estimated rate base was provided by COMSAT for 1970. This rate base was extrapolated into future years by adding time-phased investments and deducting depreciation in appropriate years. COMSAT is allowed a 12% rate of return after taxes. Annual profit and taxes were derived by multiplying the rate base by 0.24.

TABLE 7

Revenue Requirements per Transatlantic Half-Circuit
$(000)

50-50 Split

Year	Cable	Satellite	Composite
1970	32.0	30.0	31.0
1971	28.0	24.2	26.2
1972	24.8	19.1	21.9
1973	24.0	17.1	20.6
1974	20.2	13.7	17.0
1975	16.9	11.1	14.0
1977	14,3	8.0	11.1
1980	10.2	5.5	7.8

All New Capacity on Cables

Year	Cable	Satellite	Composite
1970	32.0	30.0	31.0
1971	23.4	30.0	26.1
1972	21.0	30.0	24.2
1973	18.8	30.0	21.9
1974	14.9	30.0	18.4
1975	13.8	30.0	17.1
1977	9.2	30.0	12.0
1980	5.9	30.0	7.8

All New Capacity on Satellites

Year	Cable	Satellite	Composite
1970	32.0	30.0	31.0
1971	32.0	20.4	26.0
1972	32.0	16.0	22.4
1973	32.0	14.8	20.6
1974	32.0	12.0	17.4
1975	32.0	9.7	14.7
1977	32.0	5.6	9.8
1980	32.0	3.1	5.8

NATIONAL SECURITY REQUIREMENTS

In order to assess the sufficiency of existing and planned common carrier overseas telecommunications facilities to support critical national defense needs we have informally obtained all NCS restoration priority 1, 2 and 3 circuits, expressed as equivalent 3Kc voice circuits, for the transatlantic, transcaribbean and transpacific cross sections. Table 8 indicates the range of current NCS priority requirements and existing cable and satellite capacities.

TABLE 8

	NCS Priority Requirements (Equiv. voice circuits)	Existing Cable Capacity (circuits)	Existing Satellite Capacity
Atlantic Cross Section	106-130	1203	3374 half circuits or
Caribbean Cross Section	71-123	1268	1687 circuits
Pacific Cross Section (Hawaii to Guam)	150-170	142	1646 half circuits or 823 circuits

While the DOD position (which essentially encourages the development of all modes of overseas communications facilities) is understandable, it does not come to grip with inefficiencies resulting from potential overbuilding of these facilities. If minimum essential facilities which are judged "sufficient" are those which enable a free choice of medium (cable or satellite) for restoration of all NCS priority circuits, then existing facilities in the Atlantic/Caribbean are sufficient.

The Hawaii-Guam cable may (on this criterion) have to be augmented using TASI-B or other compression techniques unless a concomitant decrease in priority circuits results from decreased U.S. involvement in Vietnam.

Summary

National security requirements do not appear to be of overriding significance in setting national policy goals for international telecommunications facilities, particularly in the Atlantic Basin.

POLITICAL CONSIDERATIONS

For reasons which are partly rational and partly irrational, the European nations desire additional cable capacity and apparently are prepared to bring some political pressure upon the United States in defense of a position which is substantially the same as that of AT&T.

Canada and Britain are engaged in discussions about the construction of CANTAT-2, an 1840 circuit British-type cable between the two countries. Participation by the U.S. carriers in this project is probably necessary for its viability; this participation might serve as a substitute for TAT-6 (SF) as a means of fulfilling a 50-50 split. Such participation would have significant implications both for our policy posture and possibly for the balance of payments. The U.S. carriers cannot participate without FCC permission.

Prohibition by the United States both of TAT-6 and of the U.S. carriers' participation in CANTAT-2 seems likely to make European postal officials very unhappy; whether their governments will be similarly affected is problematical.

It should be noted that the United States cannot unilaterally activate satellite paths to foreign nations. A policy of complete U.S. dependence on satellite communication for future capacity needs might be met by the Europeans by a refusal to activate the necessary half circuits.

RELIABILITY

The purpose of this section is to examine the network effects of unreliability--specifically those outages which occur on satellite paths. Criteria to measure these network effects will be developed. These criteria will then be applied in two time periods (the present and those obtaining in 1980 if a pure satellite strategy is followed) to assess the seriousness of these effects.

Operator costs are proportional to the number of times a customer requests service. As a measure of these costs we use the number of requests for operator assistance which are attributable to unreliability. These requests are of two distinct types:

1) customers who cannot place a call because all operational facilities are busy.

2) customers who have a call in progress but are interrupted by an outage. (It is assumed below that all such customers immediately call for operator assistance to adjust billing and restore the call; this assumption is rather conservative.)

Knowing the operator work time involved in each of the above types of service requests would enable us to derive weighting factors to account for their relative costs. This information is not available at this time so no weighting factors are used, however it would be a simple matter to add this sophistication when the data become available.

Deficiencies of the first kind are a function of the availability of facilities. Path availability for selected satellite paths is shown in Figure 1.

Deficiencies of the second kind are a function of the number of outages. A truncated cumulative distribution of short term ($<$15 min. duration) satellite outages is shown in Figure 2.

It is assumed that satellite path outages are random. The traffic offered to these paths varies as shown below:

Path	Msgs/day (May-Sept. 1970)	# circuits (May 70)	Msg/day-circuit
US-UK	7,160	308	23.2
US-Ger	4,390	124	35.4
US-It	1,860	106	17.6
US-Fr	1,720	116	14.8

The differences in trunking efficiency measured in messages/day-circuit are due to several factors:

a) the conversation time/message

b) the operator work time (OWT)/message (this is primarily a function of the telephone plant efficiency in the foreign country).

c) the kurtosis of the traffic distribution over the 24 hour day. (The number of trunks is engineered to satisfy peak loading.)

Under IDDD, all of these factors will change. These changes should all increase trunking efficiency, judging by domestic U.S. experience. Conversation time on domestic DDD calls has been observed to be shorter than on operator handled calls, the OWT/call will decrease drastically as the percentage of IDDD calls increases, and rate reductions which accompany IDDD should tend to smoothe out the distribution of calls.

While these effects can be described in a qualitative sense, no data are available to measure their quantitative effects. It is interesting to note that the ITU engineering standard for trunk efficiency is approximately one-half of that used in the U.S. domestic network. (The ITU has established a factor of 150 conversation minutes/day or 45,000 minutes/year as equivalent to one voice circuit. The AT&T Long Lines Department averages 93,000 minute/year/circuit.)

If it is assumed that the cumulative effect of IDDD will increase trunking efficiency by a factor of two and that the expected trunking requirements in Appendix 2 of AT&T filing in Docket 18875 are correct, the following message volume will result in 1980:

Path	Msg/day circuit	#circuits	Msgs/day
US-UK	46.4	2274	105,500
US-Ger	70.8	987	69,900
US-It	35.2	514	18,100
US-Fr	29.6	856	25,400

If a pure satellite strategy for the Atlantic basin is followed, the following division of cable and satellite circuits will result in 1980: cable - 12%; satellite - 88% (AT&T filing p. 13). If no significant improvements are made in path availability from those presented in Figure 1, the following average numbers of calls will be affected per day:

Deficiencies of the first type on satellite paths:

(0.88)	105,500	(.006)	=	557	UK
(0.88)	69,900	(.002)	=	123	Ger
(0.88)	18,100	(.0055)	=	88	It
(0.88)	25,400	(.0045)	=	101	Fr
		TOTAL	=	869	rejected

Deficiencies of the second type on satellite paths (assume outages of 10 seconds or less do not interrupt a call in progress and the average holding time is 10 minutes/call) average outages/day x probability of msg on a trunk x # of trunks.

$$\frac{22.5}{30} \times \frac{46.4\ (10)}{1440} \times 2274\ (.88) = 484 \quad \text{UK}$$

$$\frac{10}{30} \times \frac{70.8\ (10)}{1440} \times 987\ (.88) = 143 \quad \text{Ger}$$

$$\frac{7.3}{30} \times \frac{35.2\ (10)}{1440} \times 514\ (.88) = 27 \quad \text{It}$$

$$\frac{10}{30} \times \frac{29.6\ (10)}{1440} \times 856.\ (.88) = 52 \quad \text{Fr}$$

TOTAL = 706 interrupted

The two effects are of approximately equal seriousness. The total of 1575 deficiencies is a point estimate; there are insufficient data for a confidence interval. If it is assumed that 10% of the daily traffic falls in the busy hour, this figure might be as high as $[557 + 484 + 52 + 101]\,3.0 + 123 + 88 + 143 + 27 = 3963$ when the troubles on the UK and France paths occur during the busy hour. (Note: UK and France paths are served by the Andover earth station and are not statistically independent; however, the Germany and Italy paths are served by the Etam earth station. The probability that deficiencies would occur during the busy hour in both independent sets of paths is extremely small and was considered negligible. The multiplier 3.0 is composed of two factors: 2.4 for the increased traffic intensity and 0.6 to account for the observed fact that busy hour holding times are longer than daily average holding times.)

The analysis to this point has dealt with long term averages rather than instantaneous effects. These effects may be serious. For example, consider the UK path during the busy hour. (All previous assumptions apply and we will assume uniform arrival rate and fixed holding time.) New demands are arriving at a rate of 10,550 calls/hour with average holding times of 12.5 minutes/call which means $\frac{10{,}550\ (12.5)}{60} = 2200$ Erlangs (calls in progress) at any time. A satellite outage over 10 seconds in duration will interrupt (.88)(2200) or 1936 calls. The median outage time is 30 seconds; therefore 88 additional calls will be rejected. We now have the situation that new calls are arriving at a rate of 10,550 calls/hour with holding times of 12.5 minutes/call plus 2000 to be reestablished with holding times of 15 minutes/call due to operator handling. Therefore the traffic intensity for the hour following the failure is:

$$\frac{10{,}550\ (12.5) + 2000(15)}{60} = 2700 \text{ Erlangs}$$

or the traffic will be enhanced by $\frac{2000\ (15)}{60} = 500$ Erlangs.

The additional 500 Erlangs would require an additional 425 trunks as a minimum plus sufficient operators to replace the 2000 calls within one hour. If the average operator work time/complaint is 5 minutes (2.5 minutes on line and 2.5 minutes to correct billing), this would indicate a requirement for 10000/60 or 167 operators on standby. If 10% of normal calls are operator handled with 5 minutes average OWT, this amounts to $\frac{1055\ (5)}{60} = 88$ operators needed for normal operations.

The 167 standby operators thus would represent a 200% increase in operator work force. These assumptions, however, would require customers to wait an average of one-half hour for their interrupted call to be reestablished. If instead the system were engineered so that the interrupted customer only waited an average of 5 minutes for a reconnect (all interruptions restored in 10 minutes) it would require some 2000 additional trunks and 1000 operators on standby. (See Figure 3.)

It is concluded that automatic restoral of outages is essential in the presence of IDDD and the forecast demands in 1980.

A similar analysis based on today's network is much less compelling.

Assumptions:

1) 15% of daily traffic occurs in the busy hour.
2) 15 minutes is the average holding time per call.
3) satellite outages are the same.
4) traffic data are shown in Table 1.
5) UK path considered 142 satellite circuits, 166 cable.

$$\frac{1074\ (15)}{60} = 269 \text{ Erlangs}$$

A satellite outage interrupts 124 calls in progress. In 30 seconds 9 additional calls are rejected. To restore within one hour $\frac{133\ (5)}{60}$ = 34 Erlangs plus the 269 original resulting in 303 Erlangs on 308 trunks no additional trunks are needed. $\frac{133\ (5)}{60}$ = 11 additional operators are needed on standby. To restore within 10 minutes, 133 Erlangs plus 269 original is 402 Erlangs requiring 94 additional trunks and 66 operators on standby. However, in an all operator environment with an ability to queue calls the effect of the outage can be spread to many more subscribers. Instead of requiring the 133 interrupted parties to wait an average of one-half hour for replacing their call, the operators could delay all incoming calls for about seven minutes and effectively extend the busy hour by that amount of time.

It appears that, at least initially, the TASI-B in the "circuit multiplication" mode is more efficient than its use in the "diversity" mode. A crossover point varying with increasing operator costs apparently exists, but the data at hand are not precise enough for prediction.

The advantages of IDDD appear to far outweigh the costs of autpmatic restoral of trunking. The automatic restoral equipment need not, and probably should not, be as expensive as TASI-B. Equipment without the automatic speech interpolation feature should be much less expensive.

Findings and Conclusions:

1) The availability of satellite circuits from September 1969 to present for European paths is considerably better than reported in Docket 18875. The satellite path availability is now between 99.4% and 99.8% (see Figure 1). Bell in filing for a domestic satellite system (Docket 16495) has engineered its system for 99.99% availability. We can reasonably expect further improvements in satellite path availability with additional experience and backup facilities mainly in the form of redundant antennas and an in-orbit spare satellite. Similarly, improvements in the availability of cable facilities should be realized with improved techniques such as burying cables in ocean bottoms in known fishing areas. The path availability of these two media should become roughly equivalent and will be practically limited by the state of technology and the cost which customers and foreign correspondents are willing to pay for very reliable service.

2) The number of satellite path outages is heavily weighted toward short duration outages (today's median outage is about 30 secs), primarily due to earth station failures. These short term outages may be approximated by $P(O_t) = \frac{b}{t}$ where $P(O_t)$ is the probability of an outage of duration of t secs, b is a constant and t is the duration of the outage. These short term outages are peculiar to satellite paths. Their effects are sufficiently serious in disrupting busy hour traffic in the era of IDDD, to require automatic restoration of satellite circuits in that time frame. Automatic restoration could be over any independent set of available facilities (either satellite or cable) and the necessary electronic equipment should not be as expensive as TASI-B since it does not require the speech interpolation equipment.

FIGURE 1

CONTINUITY of SERVICE

12-MONTH AVERAGES - 21 SEP. 1969 - 20 SEP. 1970

SELECTED PATHS - U.S. TO EUROPE

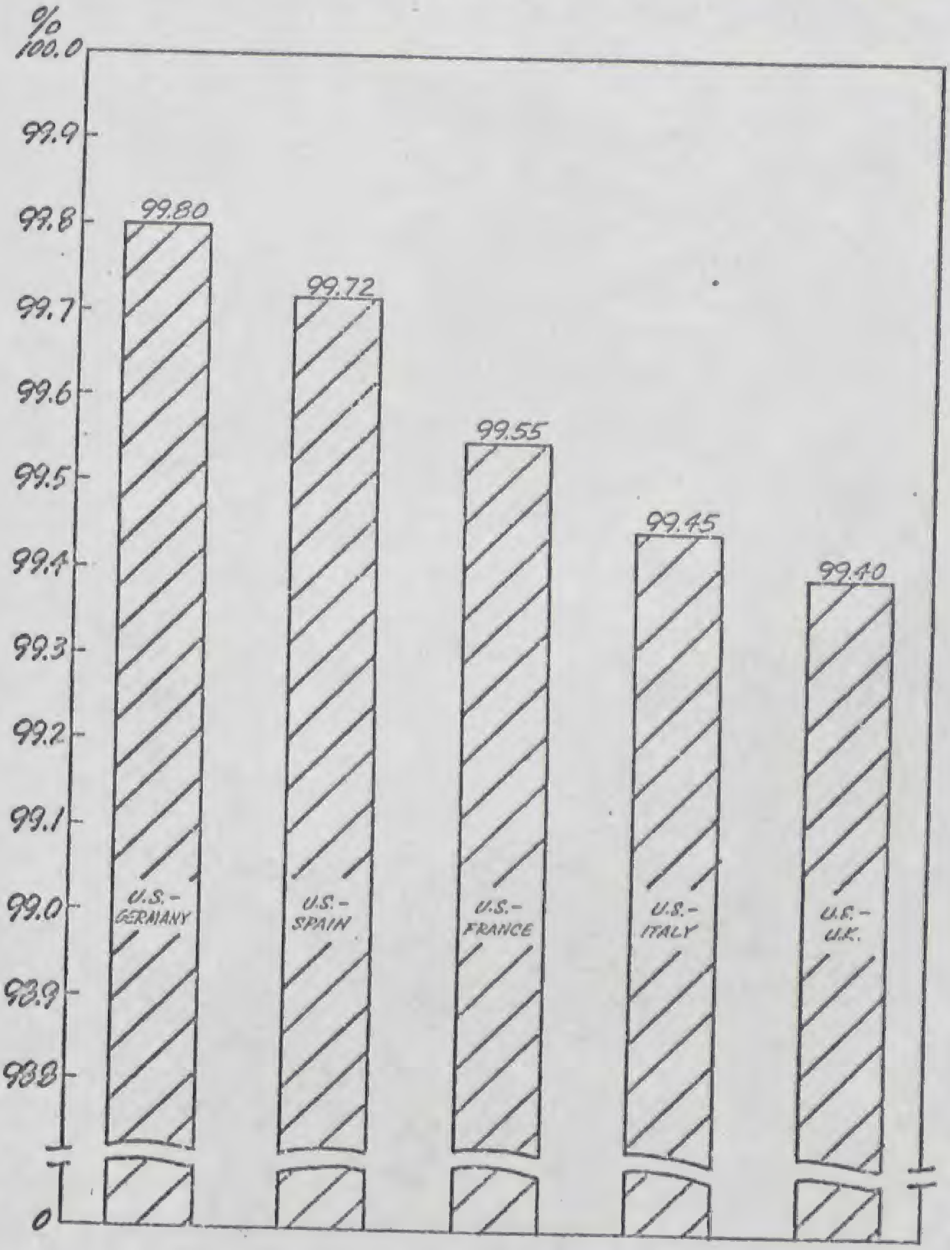


FIGURE 2

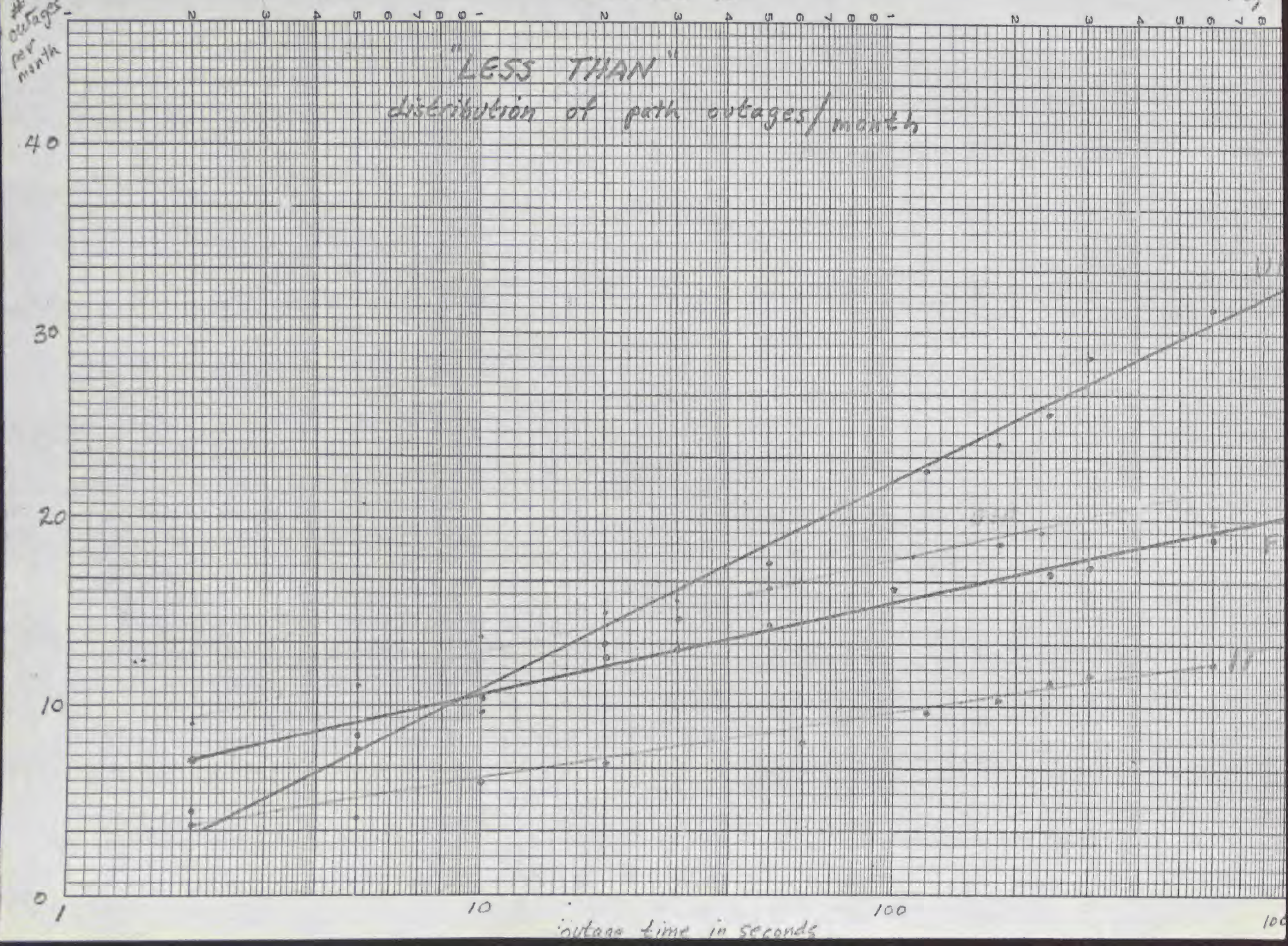


Fig 2
outages per month
"LESS THAN"
distribution of path outages/month
40
30
20
10
0
1
10
100
outage time in seconds

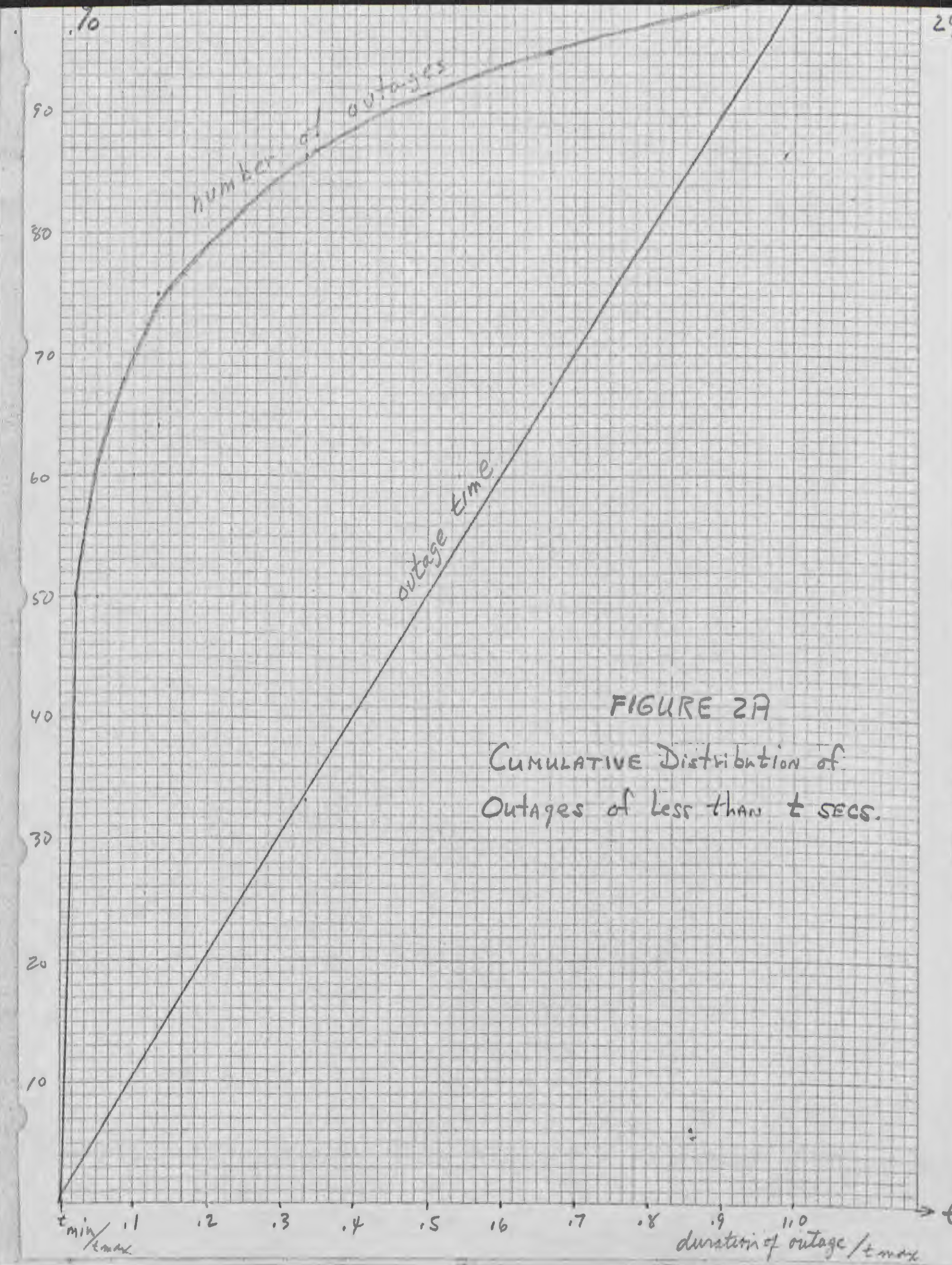


FIGURE 2A

Cumulative Distribution of Outages of less than t secs.

Notes to Figures 1 and 2

The two measures of system performance degradations due to unreliability, e.g., calls rejected and calls interrupted, are functions of two distinct variables.

calls rejected $\simeq$ outage time

calls interrupted $\simeq$ number of outages

From Figure 2 N the cumulative number of outages with duration of t or less can be expressed analytically as:

$$N = b \ln t$$

and the number of outages of duration t is

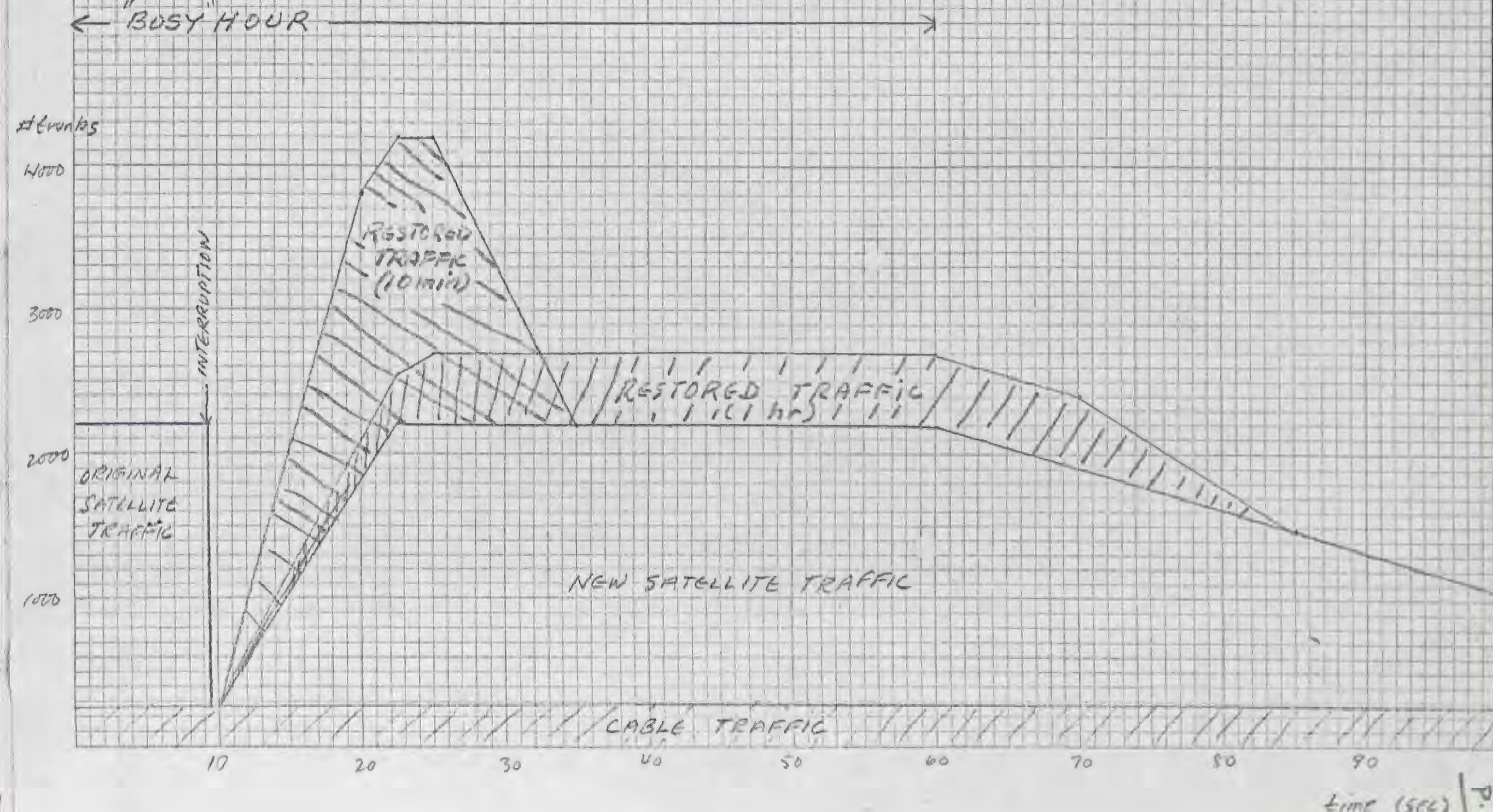
$$n = \frac{dN}{dt} = \frac{b}{t}$$

The outage time attributable to n outages of duration t is nt or b.

Total outage time is $T = \int_{t_{min}}^{t_{max}} b \, dt$ or $b \, t_{max}$ when $t_{max} \gg t_{min}$.

The number of outages is weighted heavily in favor of the great number of short term outages which contribute little to the total outage time. (See Figure 2A.) It should be noted that the analytical expressions developed here apply only to outages of duration between two arbitrary limits t_{min} and t_{max}. These distributions do not hold between 0 and t_{min} and between t_{max} and ∞. In practice, this is not too harmful approximation in that t_{min} can either be set by the accuracy of the equipment which measures outages (approx 1 sec) or by the smallest outage which could cause network degradations (approx 10 sec since there is no automatic supervision on international trunks), and t_{max} would be set by the time which would be necessary to reroute interrupted channels over other media (satellite or cable) so that outages greater than t_{max} would not have any network effects. The three month sample is long enough to accumulate sufficient number of outages for estimation purposes. Hosever, it is not long enough to generate the longer duration outages which contribute toward system availability but occur only rarely.

FIGURE 3



"BUSY" HOUR
#trunks
4000
3000
2000
1000
INTERRUPTION
RESTORED TRAFFIC (10 min)
RESTORED TRAFFIC (1 hr)
ORIGINAL SATELLITE TRAFFIC
NEW SATELLITE TRAFFIC
CABLE TRAFFIC
10
20
30
40
50
60
70
80
90
time (sec)

Notes to Figure 3 (Continued):

Let $f = \dfrac{\Delta_s}{\Delta_c}$

$$\phi = (f\,C_s + C_c)\,\Delta_c + k\,(1 + f)\,\Delta_c$$

$$= [f\,C_s + C_c = k\,(1 + f)]\,\Delta_c$$

but $K \propto = K\,(1 - \frac{C}{T}) - \frac{K}{T}\,\Delta_c = \Delta_s + \Delta_c$

let $g \quad = K\,(1 - \frac{C}{T}) = \Delta_s + (1 + \frac{K}{T})\,\Delta_c$

then $\phi = \dfrac{[f\,C_s + C_c = k\,(1 + f)]\,g}{1 + \frac{K}{T} + f}$

$$\phi = \frac{g\,(C_c + k) + g\,(C_s + k)\,f}{1 + \frac{K}{T} + f}$$

which is of the form

$$\phi = \frac{a + b\,f}{c + d\,f}$$

where
$a = g\,(C_c + k)$
$b = g\,(C_s + k)$
$c = (1 + \frac{K}{T}) = (1 + \frac{t_h}{t_r})$
and $d = 1$

$$\frac{d\,\phi}{d\,f} = 0 = \frac{(c + d\,f)\,b - (a + b\,f)\,d}{(c + d\,f)^2}$$

$$0 = (c + d\,f)\,b - (a + b\,f)\,d$$

$$0 = bc - ad$$

$\dfrac{d^2\phi}{df^2}$ vanishes

Case 1: when bc=ad cost is independent of f and we are indifferent as to cable-satellite mix for additional facilities.

Notes to Figure 3 (Continued):

Case 2: When bc > ad min cost is $\emptyset(o) = \frac{a}{c}$ and all cable mix is indicated for additional facilities.

Case 3: When bc > ad min cost is $\emptyset(\infty) = \frac{b}{d}$ and an all satellite mix is indicated for additional facilities.

It is interesting to note that this unstable situation is similar to the results based on a cost analysis for a given route, e.g., it will be all cable or all satellite.

POLICY OPTIONS FOR OTP

We have identified four possible policy options for OTP on this issue. There are others, but these seem to us to be the most plausible:

1) Make specific recommendations regarding the way in which regulatory decisions in this area should be made.

2) Make specific recommendations regarding TAT-6, the 50-50 proposal, and the optimal timing of investments.

3) Make recommendations which have the effect of restructuring the industry along the lines suggested by the Rostow Task Force and others -- creation of a single entity.

4) Make recommendations to the effect that the Commission inquire into the possibility of competition between the two media by means of direct user choice of medium.

There is, of course, a fifth option, which is to do nothing.

Discussion

Policy Option 1

Possible examples of this course of action include recommendations to the effect that the Commission settle on an explicit standard of reliability and then achieve that standard over time by the cheapest technology; that there is some optimal mix of facilities which the Commission should determine and then implement; that the Commission should authorize facilities and tariffs but not fill rates; that the Commission should determine which technology is cheaper and then disapprove investment in the other technology except for research.

Policies of this sort formulated by the Commission seem likely either to be too vague to be meaningful or too specific to be relevant over any considerable period of time. They also uniformly require data and analytic resources which the Commission may not have or wish to devote to this problem.

Policies such as these have in the past been heavily cirumscribed by ad hoc political compromises made with the carriers and the foreign correspondents in the context of each individual investment. These compromises seldom present a coherent or rational policy posture; this results in a complete re-evaluation of the policy when the next facility is proposed, with the same result.

Policy Option 2

If we decide on the basis of our analysis that a particular choice of technology is correct, we could simply transmit this intelligence to the Commission. We might say, for instance, the obvious: that TAT-6 in an SF mode is clearly inefficient unless there is some justification for a 50-50 split; that we can find no justification for any arbitrary split; and that therefore TAT-6 should not be approved at this time. We might also point out that the Commission has authorized and COMSAT has purchased sufficient capacity to satisfy demand for some time, and that new investment in any medium now is a waste of resources.

These recommendations have certain drawbacks, not the least of which is that it is not impossible that they are wrong. The first four INTELSAT IV flights might blow up on the launch pad.

Perhaps more serious, these sorts of recommendations are simply adoption by OTP of the same ad hoc decision-making posture which has worked poorly at the Commission. They are not policy decisions but operational decisions.

Policy Option 3

The concept of a single entity has been proposed many times. The principal merit of the proposal is that the single entity would make internal decisions about investment in new facilities under an incentive structure which might better achieve efficiency than the present decision process. The carriers now look to the Commission, instead of their customers, as the source of demand, and they may be motivated to propose things which may not be best for their customers, and to mislead the Commission.

The disadvantages of this policy are that it has been proposed before and not implemented because of its high political cost; that it despairs of the perfectability of regulation; and that it creates a monopoly in an area where competition may be possible.

Policy Option 4

The thrust of this policy is that the Commission be urged to inquire into the feasibility of competition as a substitute for at least part of the regulatory process. We suggest that users be allowed to specify directly their choice of international transmission medium through the established dial up or operator procedure, and that differential costs of such choices be passed on to users through the AT&T billing mechanism. Thus, we do not abandon the "authorized user" decision; we merely require AT&T to establish differential overseas tariffs which reflect, respectively, the costs to it of satellite and cable circuits.

The advantage of this policy is that the Commission could abandon regulation of investment and fill rates, leaving these variables free to respond to the actual demands of consumers through interaction with actual experience with the alternative costs and reliabilities of the media. It makes the carriers responsive to the needs of their customers rather than to the Commission.

Another advantage of this proposal is that it eliminates that feature of our regulatory process which most annoys the Europeans: the circuit by circuit activation procedure. Instead, we allow the mix of traffic to find its optimal level automatically, by allowing consumers to make the trade-off between cost and reliability differentials. This policy does not, it should be noted, foreclose the "single entity" possibility. If in time one technology comes to dominate the other, we will have arrived automatically at the single entity concept without the need for explicit institutional reform. A final advantage is that this proposal considerably reduces the detailed regulatory decision-making now required of the Commission, and thus reduces the drain on the Commission's resources.

The disadvantages are that the Commission would have to be careful about cross-subsidy between AT&T and its cable facilities and about the motives of AT&T in supplying information regarding the technical feasibility of allowing choice in the context of IDDD. Tariffs would still have to be regulated, and the carriers might over time cease to compete and form instead an implicit cartel.

CONCLUSIONS AND RECOMMENDATIONS

Policy Option 4 -- Competition -- seems to us to be the most rational and reasonable posture for OTP to adopt. It has the advantage of being consistent with the domestic satellite policy. If convincing evidence is brought forth that such a policy is technically infeasible -- which seems unlikely -- then we will be somewhat embarrassed.

Elements of the other options could also reasonably be adopted in the OTP position. Most prominently, we would draw attention to the irrationality of any arbitrary mix of facilities, to the apparently very low costs of several compression techniques, and to the fact that we have already committed resources to sufficient satellite capacity to satisfy projected demand for some years.

There is some feeling that the importance of this issue in quantitative terms does not pose a large threat to the public interest in comparison with other issues before us. If implementation of a policy position here involves a significant quantum of our resources, these resources might benefit the public more if expended on other issues.

Discussion of some disadvantages of Policy Option 4

1) By splitting a single trunk group into two separate trunk groups, eg. cable and satellite, the trunking efficiency is reduced. This becomes intolerable with small cross-sections. Illustrative of this effect using Poisson tables for P10 and P03* grades of service are shown:

Number of trunks in original single trunk group	% overbuild required for two equal sized groups	
	P-10	P-3
250	4	5.2
200	4.5	6.5
150	4.7	6.7
100	6	8
50	8	10
40	10	12.5
30	13	16.5
10	20	30

* P10 is minimum grade of service with operator dial.
P03 is minimum grade of service for acceptable IDDD.

Trunking inefficiencies suggest that competitive services be offered only to countries whose aggregate trunking requirements exceed 50 trunks. Today this would include:

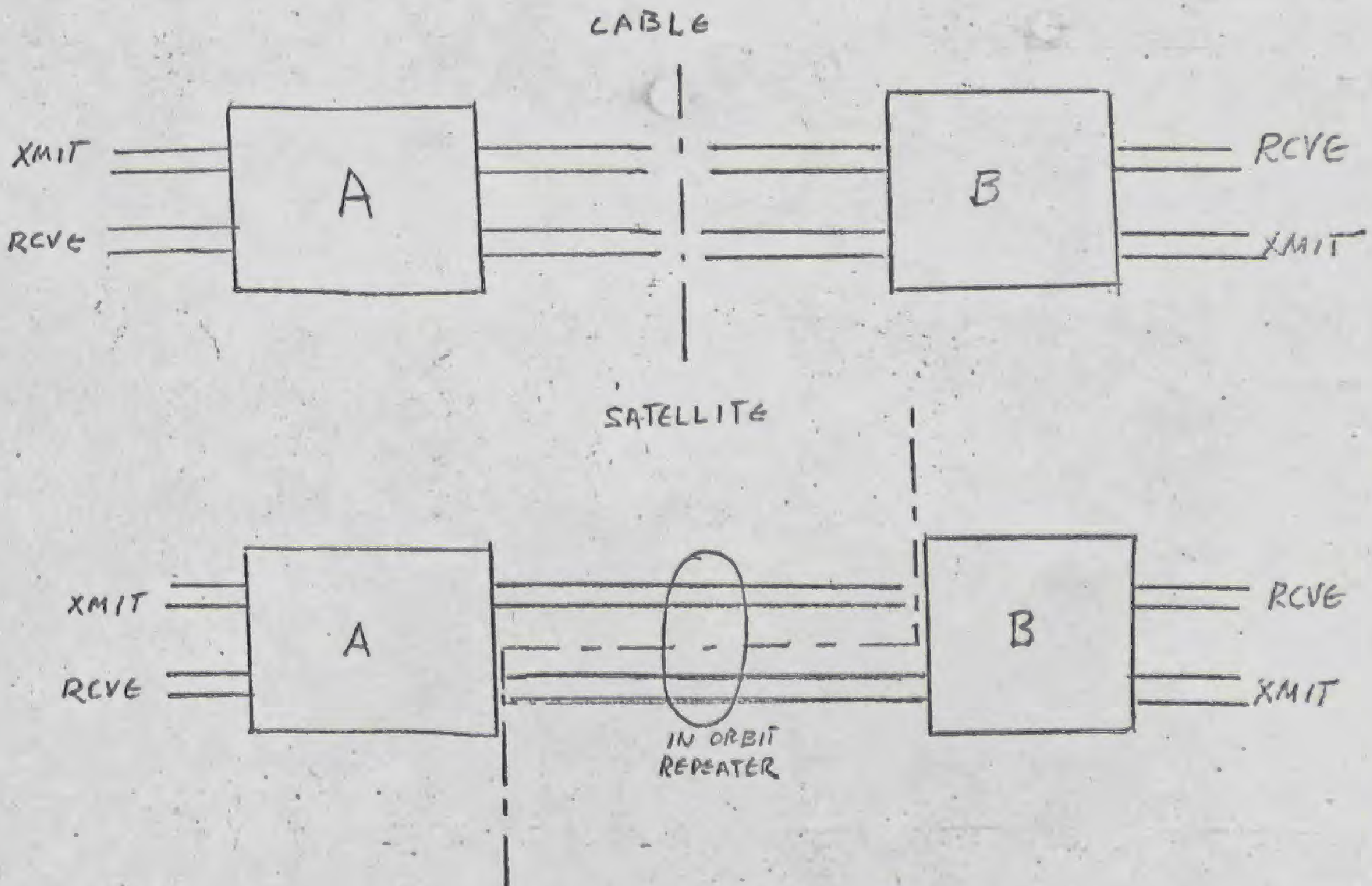
U.K.	389
Germany	179
France	129
Italy	110
Spain	54
Bahamas	147
Jamaica	67
Dominican Republic	51
Puerto Rico	350
Virgin Islands	79
Panama	58
Venezuela	66
Hawaii	260
Japan	96

2) There will be costs involved in implementation for IDDD. The most economic implementation would involve a modification of the gateway exchanges to recognize "shadow countries" for destinations where the service was offered, eg. England, cable 44 + 8 or 9 digits, England, satellite 48 + 8 or 9 digits, etc. However, this would require CCITT approval of changes to the international numbering plan. This may be opposed by the foreign correspondents for external motives, to be discussed later. One might, equivalently, designate two gateway stations (one for cable, one for satellite) and avoid changes to the numbering plan.

3) Foreign correspondents may not concur in our allocation of circuits between satellites and cables. They most probably will insist that any trunking inefficiencies on their half circuits will be offset in revenue distributions. They may artificially raise tariffs on their satellite half circuits in order to ineffectuate any COMSAT reductions, thereby influencing the resultant facilities mix. A discussion of a conceptualization which largely avoids these problems and promises maximum operational autonomy follows.

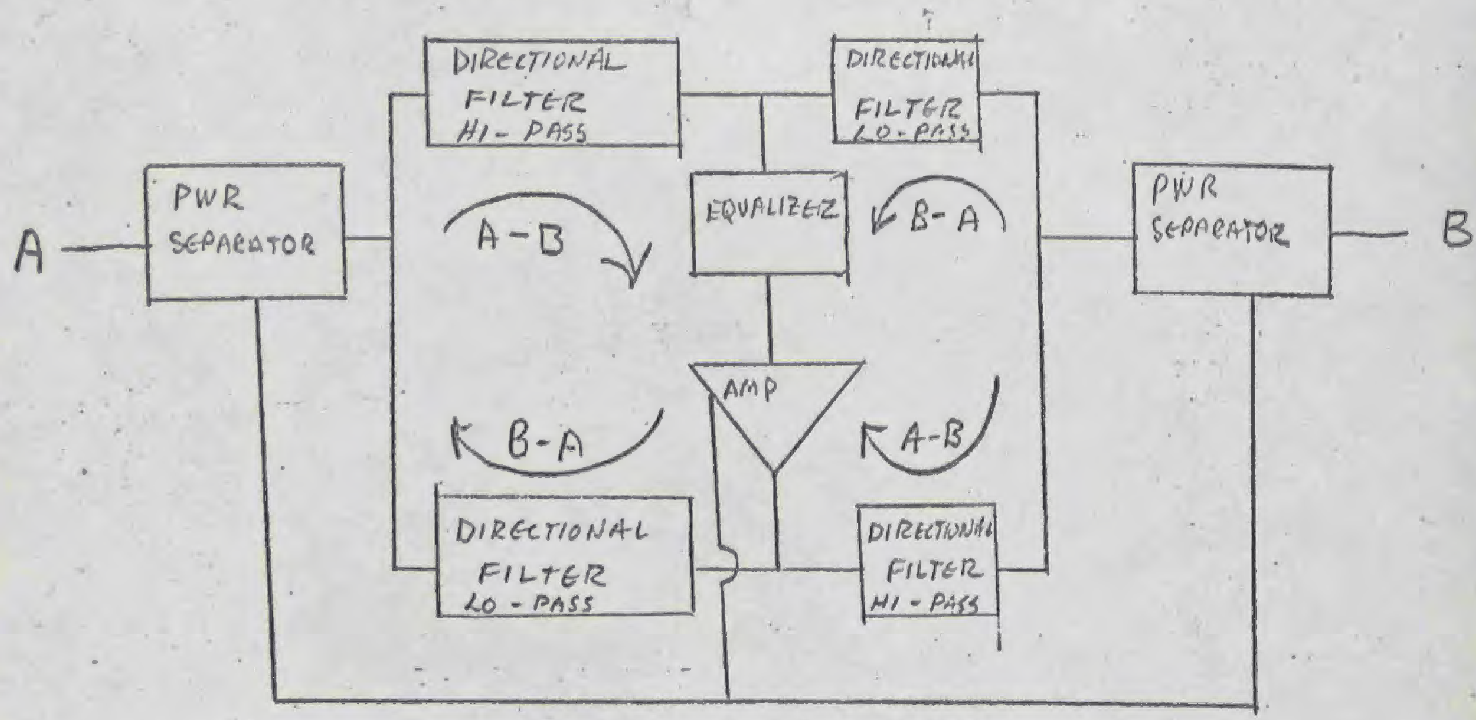
A half circuit is presently defined differently for satellite and cable circuits. Satellite half circuit definition includes a transmit path from the earth station to the satellite and a broadcast from the satellite to all earth stations. With proper termination equipment at the desired receiving earth station, a satellite half circuit provides a one-way communications path. Two such half circuits, one in each direction, then provide a two-way voice channel.

Cable half circuits as now defined in legal indefeasible right of use agreements include proper termination for transmit and receive paths and a proportionate distance (to approximate mid-ocean) of cable capacity. Two such half circuits, properly matched, each providing two-way transmission for half the distance, then provide a two-way voice channel. This difference is illustrated graphically below:



In actual operating practice hybrid two-way voice channels are sometimes used, eg. satellite one-way and cable the other way. This hybrid mode of operation currently is occasionally used to ameliorate the effects of inadequate echo suppression which sometimes occurs in "pure" satellite channels. More importantly, this indicates that individual one-way paths are interchangeable, eg. satellite or cable, in an operating voice channel.

Early cables such as TAT-1, TAT-2, and Florida-Puerto Rico employed one-way repeaters and required two cables, one for each direction of transmission. This design has been superseded by the two-way repeater with a single cable shown:



Presently, the directional filters and pilot frequencies are arranged such that the number of B-A half circuits equals the number of A-B half circuits. However, technically it would be possible to vary the share of cable capacity assigned in each direction in the design of the cable. Once in operation, this share of capacity is fixed since tunable filters would be impractical.

By defining a cable half circuit in the same manner as a satellite half circuit is presently we can obtain operational autonomy via the following international agreement. We will activate mixes of transmit pairs by any U.S. formula and would allow foreign correspondents to activate their transmit pairs as they desire. We would properly terminate any and all half circuits they choose to activate. In return we would ask that they reciprocate for our choice of transmit pairs.

Tariffs to U.S. customers would be twice the revenue requirements for the U.S.-owned half circuits. These revenues would be split with the foreign correspondent as it now is done. Likewise, the foreign correspondent would share his revenues with us as now. Thus, foreign pricing of half circuits would not affect U.S. customer tariffs.

We would view our complement of transmit pairs in two separate trunk groups, however the foreign correspondent could look at his set of transmit pairs as a single trunk group. He would thus be required to terminate a few more half circuits than we might; but this should represent a very small investment differential which could be negotiated between AT&T and the correspondent.

4) In the era of domestic satellites it may prove costly to prevent "double-hop" connections where a subscriber selects the satellite overseas medium. This might be overcome by equipping the twelve regional switches (or whichever switches directly serve the proposed earth stations) with special routing instructions to ensure a terrestrial link to the gateway. Switch modifications are roughly estimated to be on the order of $100 K per switch.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF TELECOMMUNICATIONS POLICY
WASHINGTON, D.C. 20504

Date: January 4, 1971

Subject: Satellites and Cables

To: Mr. Clay T. Whitehead

The comparative analysis of cables and satellites for international communication enclosed led to these findings and conclusions:

1) While cables employing SF technology, as in the proposed TAT-6, are clearly uneconomic, it is not unlikely that the next generation of cable (SG) will be comparable in cost to satellites of the Intelsat IV type at projected demand levels. The costs of these two technologies are sufficiently close that no accurate prediction can be made as to which will in fact turn out to be cheaper. There do exist some routes and traffic cross sections for which cables are a cost-effective medium on a point-to-point basis. When the global coverage and flexibility of satellites are considered, it is likely that satellites are a superior system.

2) Existing cable capacity in the Atlantic Basin is capable of handling all national security priority circuits many times over, and additional cable capacity can not be justified on national security grounds. In the Pacific, there may be a case for some additional cable capacity on national security grounds.

3) There are insufficient data to accurately assess the reliability characteristics and costs of outages of the alternative media. It is not obvious that satellites are less reliable than cables in terms of the impact on the probability of gaining access to an international circuit. Without some form of automatic restoration, satellite circuits do appear to suffer from many short duration outages which will interrupt calls in progress at the time of the failure. There is at least inferential evidence that satellite systems can be made as reliable as cables.

4) Among the policy options which are available, these findings seem to us to indicate that competition between the two media for the business of users should be allowed to determine the optimal mix and timing of facility investment.

We therefore recommend that users be allowed to specify their choice of medium through AT&T, that AT&T be allowed to build cable capacity and to lease satellite capacity sufficient to satisfy these demands, and that the prices charged by AT&T to users reflect the cost to AT&T of providing service on the alternative media at differential rates.

We further recommend that the circuit-by-circuit activation procedure be abandoned, and that the definition of ownership in half circuits in cable systems be altered to conform with the existing satellite ownership definitions. Foreign entities would then be free to choose their own medium for return half circuits without dictation by the FCC.

Seb Lasher
Sebastian Lasher

Bruce Owen

Enclosure

OFFICE OF TELECOMMUNICATIONS POLICY
WASHINGTON

January 12, 1971

DIRECTOR

To: Bruce Owen
Seb Lasher

From: Tom Whitehead

Regarding the memo on satellites and cables, I don't think this recommendation is feasible. We've got to find another approach. I have discussed the whole thing with George, and he and I will have a meeting when we return.

—By Walt Kelly

THE SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

Calbro Satellite

DEC 1 6 1970

Honorable Dean Burch
Chairman, Federal Communications Commission
1919 "M" Street, N.W.
Washington, D. C. 20554

Dear Mr. Chairman:

Several weeks ago my Assistant for Telecommunications, Mr. Louis A. deRosa, wrote to the White House Office of Telecommunications Policy with respect to your "inquiry into policy to be followed in future licensings of facilities for overseas communications." Our views were that as a matter of policy we supported actions on the part of the FCC which stimulate and encourage the growth and expansion of telecommunications throughout the world.

This DoD position is based in a large measure on the reliance which we must place on the common carriers for supplying international commercial communications. Our experience as a user supports the concept that high capacity submarine cable systems and satellite systems provide the best mix of complementary rather than competitive systems for meeting the compelling needs of national security and defense communications.

We further advised that we would respond to the Commission within the framework of these general policy views, with regard to specific applications by carriers. In this connection we have been studying the applications of the AT&T Company and other participating U.S. international common carriers to construct a new transatlantic cable (TAT-6) linking the U.S. with France, and extending a number of cable circuits from the French landing point directly to the Federal Republic of Germany as well as providing access into the domestic facilities in France. We note in the application for TAT-6 that the existing transatlantic communications facilities will soon be fully utilized and that additional circuits will be sorely needed within the next two or three years. Our review of previous transoceanic cable and satellite system applications tends to bear out the fact that justifications presented for additional facilities have been understated.

In addition to supporting the growth of international commercial communications facilities from which the DoD can selectively fulfill its needs, we are, of course, also interested in the substantial contributions that these additional facilities provide in the trend toward reducing costs through rate reductions.

Since the AT&T Company and other participating carriers wish to construct another high quality communications path across the Atlantic without obligating the Department of Defense, we strongly support the TAT-6 applications and a favorable response thereon by the Commission.

Sincerely,