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GOVERNMENT

OPERATIONAL REMOTE SENSING LEGISLATION

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HEARINGS

KANSAS STATE UNIVERSITY

BEFORE THE

SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

NINETY-SIXTH CONGRESS

FIRST SESSION

ON

S. 663

TO ESTABLISH AN EARTH DATA AND INFORMATION SERVICE,
IN THE NATIONAL AERONAUTICS AND SPACE ADMINISTRA-
TION; AND FOR OTHER PURPOSES

AND

S. 875

TO PROVIDE FOR THE ESTABLISHMENT, OWNERSHIP, OPERA-
TION, AND REGULATION OF A COMMERCIAL EARTH RE-
SOURCES INFORMATION SERVICE, UTILIZING SATELLITES
AND OTHER TECHNOLOGIES, AND FOR OTHER PURPOSES

JULY 31, 1979

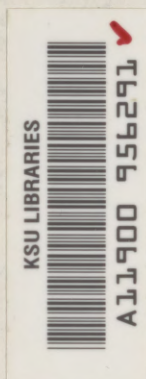
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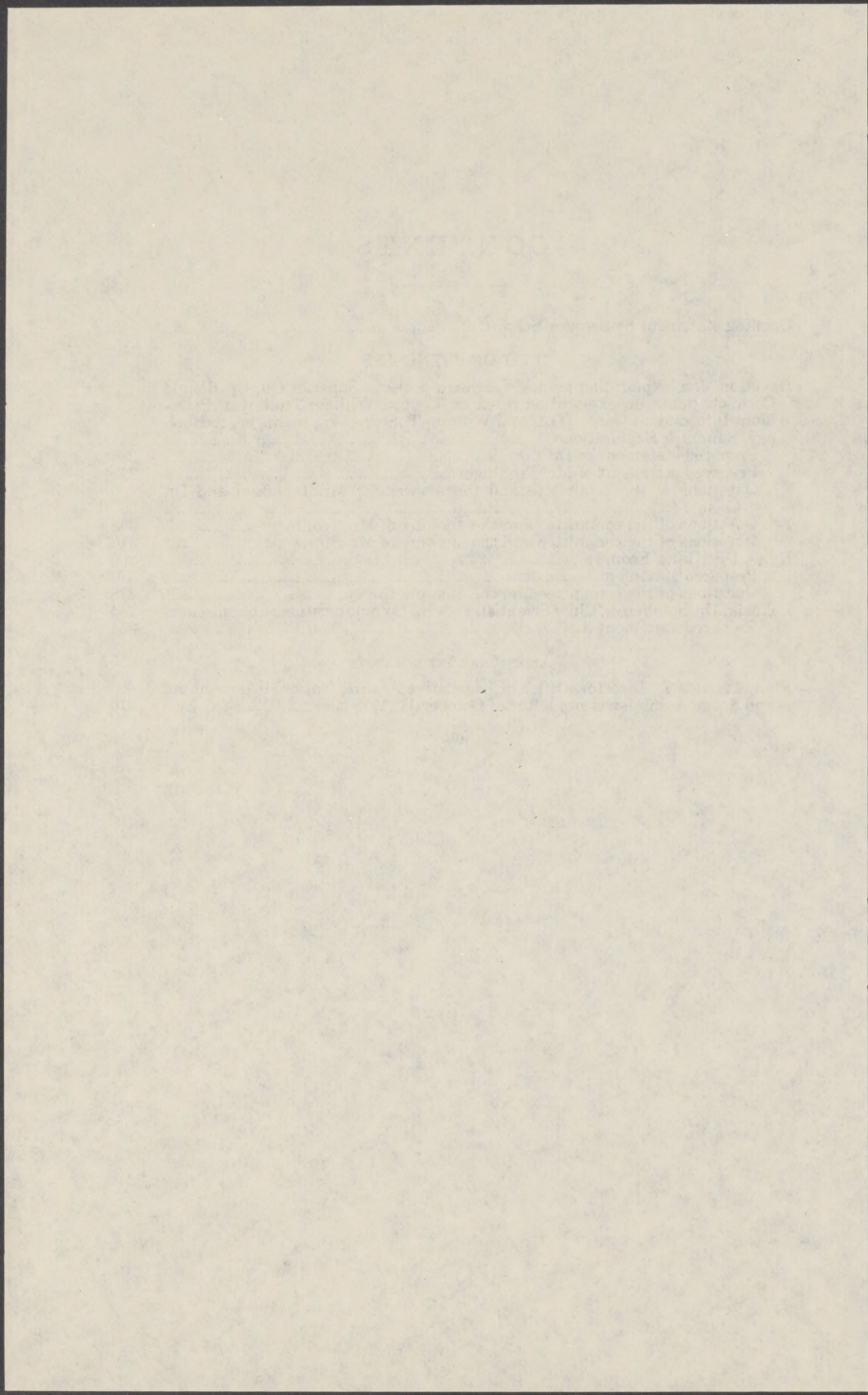
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OPERATIONAL REMOTE SENSING LEGISLATION

TUESDAY, JULY 31, 1979

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE,
Washington, D.C.

The subcommittee met at 9:40 a.m., in room 6226 of the Dirksen Senate Office Building, Hon. Adlai E. Stevenson (chairman of the subcommittee) presiding.

Senator STEVENSON. The subcommittee will come to order.

This morning, we will receive additional testimony on S. 663 and S. 875, bills to establish an operational system of remote sensing satellites. I am hopeful that the full committee will be in a position to report a remote sensing bill shortly after the August recess. That will be an objective of ours, so I hope the administration will accelerate its efforts and give us the benefit of its advice before we have to make any decisions.

Senator Schmitt?

Senator SCHMITT. Mr. Chairman, I would ask my opening statement be part of the record in its entirety.

Senator STEVENSON. Without objection.

[The statement follows:]

OPENING STATEMENT BY SENATOR SCHMITT

Today's hearing is a continuation of earlier hearings held by the Science, Technology, and Space Subcommittee on S. 663, the Earth Data and Information Service Act of 1979, and S. 875, the Earth Resources Information Corporation Act of 1979. Both bills are directed at the establishment and implementation of an operational Earth resources data and information system.

The benefits to be derived from such an operational system are numerous, widespread throughout the economy, international in scope, and certain to multiply in the future. Now that the Administration has gone on record in support of an operational system, a decision I might add that was due in large measure to the persistence of this Subcommittee in highlighting the many benefits available from an operational system, attention must now focus on the form such a system will take and the timing of the transition from an R. & D. to an operational structure.

There are, however, numerous questions that still need to be answered. These questions relate to the proper location of the system, either within the Federal Government or the private sector, or perhaps some combination of the two; the size and continuity of demand for Earth resources data and information; and the interaction of an operational U.S. system with the international community. The creation of such an operational system must include consideration of the development and expansion of additional markets for such data and services, the readiness of the private sector to invest in an operational Earth resources information system; the role of the Federal government as a purchaser of such data and services; and the possibility of including environmental and ocean data and information in the system.

Whatever the final decision on these important issues, we must ensure that the private sector is a major contributor to the decision process involved in the move toward the establishment of an operational remote sensing system. The Chairman and I are committed to the establishment of an operational remote sensing system.

Hopefully this can be done with the active support of the executive branch and the private sector. We cannot afford to wait however. Just as in other areas of space utilization and applications, if the U.S. fails to act and maintain its leadership, others will step in to fill that role. Such is the case with an operational remote sensing system. The time to act has arrived.

Senator SCHMITT. I would just say it appears that we have the administration now committed to an operational system for Earth remote resources sensing. I would hope that in fact remains their position and that the committee and the administration can come to some kind of agreement on the pace and nature of that system. I know you and I can come to some kind of agreement. I am not sure yet about the rest of the Government.

I do expect, however, we can also reach agreement with our colleagues in the other body. There are still a number of questions left to be answered about the issues before us.

These questions relate to the proper location of the system within the Federal Government or the private sector or perhaps some combination of the two, the size and continuity of the demand for Earth resources data and information, interaction of the system with the international community, and so forth.

These hearings today, I think, will assist us in answering some of those questions. I am happy to see the list of distinguished witnesses to testify today.

Thank you, Mr. Chairman.

Senator STEVENSON. I concur in those comments, including the suggestion that it should be easy to reconcile the differences in the two bills.

Our first witness is Dr. Stephen Lukasik, chief scientist of the Federal Communications Commission.

STATEMENT OF DR. STEPHEN J. LUKASIK, CHIEF SCIENTIST, FEDERAL COMMUNICATIONS COMMISSION

Senator STEVENSON. I will invite all our witnesses to summarize their testimony. Their full statements will be entered in the record.

Dr. LUKASIK. Mr. Chairman, members of the subcommittee, I am pleased to have this opportunity to present my views on the two bills, S. 663 and S. 875, dealing with the provision of Earth resources information from an operational satellite system.

I would like to submit, with your permission, a statement for the record and restrict my comments this morning to some brief summarizing points.

Senator STEVENSON. Thank you. The full statement will be entered in the record.

Dr. LUKASIK. Thank you.

I will focus on the proposed structural arrangements as they impact on regulatory issues. The regulatory issues are enumerated in S. 875 in section 201(c) very well.

The fundamental point in our analysis is that there are two segments to an Earth resources system, a space segment and its associated ground control stations, which constitute a natural monopoly in the sense that these are expensive and are unlikely to be duplicated. Then there are data processing, analysis, distribution, and user service functions, which relate to the utilization of the information and is the part of the information system that can,

and I feel would, profit very much in operating in a highly competitive environment.

The second major point on which I base my remarks comes from the experience of the FCC in the regulation of the communications industry. The point to be made here is that I feel it would be most useful and efficient if one could restrict the regulatory functions to the absolute minimum necessary to carry out the purposes of an Earth resources information system. I believe that the greatest efficiency will be provided if one allows for the greatest possible role for competition in such an enterprise.

Now, the two bills under consideration treat the natural monopoly aspects in different ways. S. 875 establishes a private investor-owned corporation that would be regulated along conventional rate of return regulation lines.

S. 663 establishes, at least initially, a Government operation with a transition to some unknown arrangement at some uncertain time in the future but within 7 years after its establishment by these acts. These acts also foresee vertically integrated organizations from the design of the system through the data distribution stage.

It is my suggestion that one can minimize regulation by appropriate structural arrangements.

In my prepared statement, on the basis of the FCC's experience in regulating the communications industry, I note four problem areas with rate-of-return regulation.

First, since its profits are based on invested capital, there is an incentive to the regulated organization to increase its capital base, the ratemaking base, and this leads to capital-intensive approaches which may not be lowest cost approaches.

The second point is that there is an incentive to keep the invested capital within the ratemaking base for as long as possible which leads to longer depreciation times and this, in turn, can retard technological innovations.

A third problem is that it is difficult for the regulator to know the details of a highly technical business better than the firm that is regulating. This would be particularly difficult in this case because there will be only one firm in the business and therefore, it will be impossible to have a basis for comparison of costs and performance.

Finally, perhaps not a major point but one that should not be neglected, is the fact that regulation incurs costs both to the taxpayer in supporting the regulator and to the ratepayer in supporting the organization that must respond to the information requests of the regulator.

In this regard, I would summarize my observations along these lines: Thus, while I grant the need to control the natural monopoly aspects of an Earth resources information system, I would suggest for at least two reasons the rate-of-return regulation of a vertically integrated private corporation as proposed in S. 875 will not in the end be satisfactory.

First, this is because the monopoly aspect of the data collection need not be inextricably linked to the distribution service aspects that will benefit from the greatest possible competition. And second, rate of return regulation establishes perverse incentives for

the monopoly firm aggravated in this case by the likelihood of a single collection system.

An alternative to this is provided by S. 663 where it is proposed the Government operate such a system. This also couples the monopoly space segment to the competitive distribution segment. One can also raise questions as to whether such a Government operation would remain innovative and responsive to user needs despite the fact that of the 17 directors, 3 would be nominated to represent user interests. Also by establishing the system on an interim basis with an uncertain future there is the question as to whether this will retard business development since people may be reluctant to make investments in an uncertain future, investments required in the costly collection facilities, distribution facilities, and in user facilities that would utilize such data.

I suggest there is an organizational alternative between these two extremes. This is a user-owned organization. Like S. 875, I suggest there be a separate subsidiary established for the distribution of the data, but the point is that in a user-owned organization, the users could be protected against monopoly charges by having a right to buy into the monopoly facilities according to their proportionate use of the system. Clearly, if users have a share in the profits proportionate to their contribution to the revenues collected, they will on net be paying cost-based prices.

I think this strikes a balance between private ownership but without establishing an organization that would require excessive regulation. The primary advantage of this is that it would provide a nonregulatory constraint on the ability to charge users monopoly prices and as a private corporation owned, at least in part, by its users, it could be expected to be responsive to user needs. Providing desired services will increase profits; reducing costs will increase profits. Overall, it will provide a healthy incentive structure.

The last point on which I was requested to comment by you, Senator Schmitt, dealt with our experience in regulating Comsat.

This is an organization established by the Communications Satellite Act of 1962 and it is the organization which is the U.S. participant in a global commercial communication system, that of Intelsat. More recently, the International Maritime Satellite Telecommunications Act gave Comsat additional responsibility as the U.S. sole participant in the Inmarsat system, an international consortium to establish a global maritime satellite system.

The legislation implementing Inmarsat requests that the FCC review the capital structure of Comsat to establish that it can undertake this new function. That study is underway and is expected to be reported to the Congress in May of 1980. Therefore, the remarks I make at this time must be considered tentative with regard to Comsat.

The FCC experience with Comsat has been that while established as a U.S. corporation, it quickly became involved in international relations and structures, and I think that is something that is likely to happen in the Earth resources information area also.

If one adopted S. 875, then the FCC would be required to be authorized under the Communications Act to license its facilities.

While I feel that the rate-of-return regulation that we have engaged in with Comsat may not be relevant to an Earth resources

system for the reason that in regulating a communications service, one is providing the facilities within which information moves, whereas in the case of an Earth information service such as we are discussing here, the issue is the information that passes through that system rather than the provision of the facility itself.

Nevertheless, to the extent that the Congress were to elect a rate-of-return regulated corporation, some of the FCC experience dealing with that type of entity would undoubtedly be useful in establishing ratemaking regulations.

The last question on which I was asked to comment dealt with problems that the FCC has had with Comsat. In my prepared statement I discuss two of them.

The first deals with the initial overcapitalization of Comsat. At the time Comsat was established, the technology was very uncertain as was the market. As a result the financing plan that was established for Comsat is now believed by some to be, for rate-making purposes, a disproportionately expensive capital structure.

Since the same conditions exist now with respect to Earth resources information, this problem could recur, unless appropriate oversight authority into its capital structure is given to the regulatory agency. The Congress may wish to consider empowering any regulatory agency charged with insuring the reasonableness of the Earth resources corporation rates with the discretion to order changes, under appropriate procedural safeguards, to the capital structure of the firm to respond to changed circumstances. The current language in the bill would have the regulator report to Congress on the appropriateness of that capital structure. What I am suggesting here would be somewhat stronger language along that same line.

The second area that has drawn attention concerns Comsat's entry into activities outside its statutory mandate. What has happened is that Comsat has established a separate subsidiary, Comsat General, that is engaging in a number of activities. SBS is one of them. They have purchased the Earth Resources Technology Corp. and they are involved in the Inmarsat program. So there has been a natural tendency for this corporation, once established, to seek opportunities for its services and abilities to meet perceived market needs.

I point out that is apt to cause either financial stresses as the result of the parent organization undertaking risks that were not foreseen when it was established or it may raise potential conflict of interest and cross-subsidization problems. Since S. 875 does not place parameters or limitations on activities which the Earth Resources Corp. may engage in, Congress may want to consider specifying the activities and the corporate structure as guidance for possible future diversification of its activities.

Mr. Chairman, this brings me to the concluding section of my statement. It is clear that my recommendation, based on a study of the FCC's 45 years of regulatory experience, is to proceed cautiously with the creation of a corporation that will require extensive Government intervention to assure its continued operation. We at the FCC have undertaken numerous steps and we are recommending still further steps that will reduce our past detailed interven-

tion in the communications industry. I cite several of them in my prepared statement.

Our experience has led me to believe that innovative services at the lowest possible cost result from free play of competitive forces in the marketplace and that one should go as far as possible without invoking unnecessary regulations.

I believe that it would be easier to correct any inequities that may result by subsequent legislative redress than to risk excessive regulation of a fledgling enterprise or have it go through the painful regulatory withdrawal process.

Nevertheless, should the subcommittee choose to report out a bill along the lines of S. 875, I respectfully suggest that such regulatory oversight as found to be required be sought elsewhere within the Federal Establishment.

The FCC responsibilities for our national communications system are too important to be deflected to this new function, however meritorious. For example, both the U.S. Geological Survey in the Department of the Interior and the National Oceanographic and Atmospheric Administration in the Department of Commerce have long experience in the operation of satellite systems and the utilization of satellite-derived data for geophysical investigations.

Certainly a partnership of these organizations with NASA could provide for the effective management or control of a private organization for the provision of Earth resources information.

I think adequate contractual mechanisms exist to link these organizations. I think Congress can maintain an oversight role through the authorization and the appropriations process.

But I believe the capabilities and resources of the FCC are more likely to be most effectively employed for the public good in the area that has been our traditional concern.

Thank you, Mr. Chairman.

Senator STEVENSON. Thank you.

Senator SCHMITT?

Senator SCHMITT. Thank you, Mr. Chairman. Thank you Dr. Lukasik for this interesting testimony which contained many good suggestions.

I am a little bit surprised, though, at the statement beginning at the bottom of page 18. Is that statement basically the position of the Commission?

Dr. LUKASIK. No.

Senator SCHMITT. Is that coordinated with anyone else in the Government?

Dr. LUKASIK. The statement was approved by the chairman and I am here as a representative of the chairman, Mr. Ferris. It represents the chairman's position. It has not been approved by the entire Commission, however, and thus cannot be considered as a position of the Commission.

Senator SCHMITT. This resembles statements we had before, where the bulk of the statement justifies a great deal of expertise and understanding of the problems raised by a particular issue but on the last page the person giving the statement backs away from any involvement.

We went through this with the earthquake bill a couple of years ago. I am sure there are other examples.

Was this statement coordinated with the Office of Management and Budget or other organizations beside FCC?

Dr. LUKASIK. No, it was not. The point I was trying to make is that I see the purposes that you and Senator Stevenson are trying to accomplish can be achieved without the need for extensive regulation, and I have presented a constructive proposal along that line. I think there are economic reasons why rate-of-return regulation may not accomplish your objectives most effectively, and I think that some combination of Government oversight using the resources of the executive branch and the oversight function of the Congress could accomplish this without bringing in the FCC, whose expertise is really in a different area.

Senator SCHMITT. Well, it may be in a different area of technology, but frankly, it's not that different from the electromagnetic spectrum, satellites, wires, computers, which are all under the jurisdiction of the FCC in the communications area. I realize in another subcommittee we are trying to decrease the regulatory activity of the FCC in the communications field. I think there are lessons to be learned from that discussion relative to the present discussion.

If regulations are required, and I am not saying whether I agree or disagree with alternatives or the analysis you made, but if regulation is required, I don't know of any other part of the Government that would have better credentials to be responsible for that regulation.

Dr. LUKASIK. I suggest if you report out a bill like S. 875 that would encompass rate-of-return regulations, you are quite right, there are methodologies that have been developed in the FCC that would very likely be useful. So I certainly grant that our experience extends into the area of regulation of corporations utilizing technology of this sort.

Senator SCHMITT. I am intrigued by your suggestion that we consider a user-based corporation which is really taking the Intelsat model and applying it to a domestic situation. I think the Intelsat model is one we ought to be more conscious of in many areas of international activity. I had not frankly drawn that correlation with the possibility of doing it on a domestic corporate level. However, I think even in that case, although it might tend to minimize the need for rate-of-return regulation or regulation in general, nonetheless, I think that regulation would be required.

Do you not think so also?

Dr. LUKASIK. Well, I would suggest differentiating between regulation and oversight. It is clear that an organization of this sort would require some kind of oversight. It would be based heavily on Government research and development investments of the past. The Government is heavily in this business. There would have to be some sort of oversight to see that the activity was developing in the direction Congress intended. Whether this would require regulation in the strong sense is a question. If one establishes a natural monopoly, if the costs of providing Earth resources information are basically low, and if the demand is high, then one does have a regulatory concern that monopoly prices will be charged to the users of the data. If, on the other hand, such information is relatively expensive and the market is more limited, then one does not

have a monopoly concern. Instead, one may have a case of Government subsidy of a socially useful service and in those circumstances one is not faced with the regulation of a monopoly in the sense of excessive pricing.

I think this question is something that will be determined by the evolution of technology and by the establishment of a market which is, of course, a major unknown. At least when Comsat was established, it was clear there was a major communications market, both domestically and internationally. I think in the area of Earth resources information, it is not clear precisely what that market is either in the size or structure.

That is one of the major unknowns. Before one goes fully into a rate-of-return regulatory structure, one should feel one's way carefully. To that extent, there must be a transition phase which is recognized in S. 663. The problem, as I indicated earlier, is that S. 633 may not provide a sufficiently stable investment environment that the market will be able to develop adequately. We certainly are faced with a transition problem of how to move this technology out of NASA, where it has been in the R. & D. phase and into the hands of some sort of commercial organization. To that extent Comsat represents perhaps the only relevant experience.

Senator SCHMITT. Comsat certainly does represent that. However, I think in the almost two decades now that we have been examining the potential of Earth resources information, the experience is now sufficiently broad and the returns sufficiently well documented that it's time to at least try the transition. S. 875 recognizes the transition. The question is the length of time and mechanism of getting through that transition. That transition could be based in part on your suggestion of a user-based corporate structure.

The advantages of a private-based structure, of course, is that generally you build in greater efficiencies in the management than you would in a purely Government or federally subsidized operation. The contrast is between A.T. & T. and the Postal Service. It would be nice to have those efficiencies relative to the Government. The suggestion that we utilize some user-based corporate structure would at least on the surface tend to protect against overpricing, because the users would be interested in minimizing the cost to themselves, while still realizing some rate of return on their investment in the operating entity.

I think we will have some very interesting discussions based on your suggestion, but I think we are still going to decide that some agency with expertise in this kind of regulatory environment—not necessarily the technology itself, but the regulation of the technology—is going to be necessary. An example of this is the FAA, which regulates a technological endeavor, namely, flying. They cooperate with agencies like NASA to make sure that their regulations are technically consistent with what is happening in the technology itself.

So you try to have your regulation transparent to technology. As a matter of fact, that is what we are trying to do with S. 622 in the communications area. We are trying to create a regulatory environment that is transparent to technology and that maximizes competition.

I think those goals in this endeavor are very good ones also.

Dr. LUKASIK. I am certainly sympathetic. I am aware of the changes in the regulatory environment in the communications industry. All I am saying here is that one should reflect that environment into the regulatory structure that one establishes for such a corporation as this one and that perhaps the rate-of-return regulated corporation may not be the way one wants to go in the future. I agree that one should attempt to establish a regulatory environment that is as transparent as possible.

It was that that was the thrust of my remarks.

Senator SCHMITT. Wasn't the original Comsat organization clearly open to the users of Comsat services and isn't it my understanding there was very little investment by the users in Comsat?

Dr. LUKASIK. I was not following Comsat in its formative phases. What you say sounds reasonable. In the early 1960's the satellite business was very risky and it would not be surprising if people did not rush in to make investments.

Senator SCHMITT. Even today where it has been a reasonably successful endeavor, apparently the major users have not chosen to invest in Comsat. Do you think that users would invest in an earth resources corporation, if it were formed?

Dr. LUKASIK. Part of the economic chicken-and-egg problem is that we do not know what the market structure will be. We know that there is a large public demand for earth resources data. The remaining market is apt to be quite diverse, consisting perhaps of a large number of small users. Whether they could usefully form consortia that could then invest in and engage in the management of such a corporation is a legitimate question.

I think that at this point we do not know what the full potential of this kind of information is, who the users would be and therefore, what market sectors or economic sectors they would represent.

Senator SCHMITT. I certainly admit that is a prevailing dogma within the Government, that we don't know, but the total quantity of users is the main thing we do not know. We have excellent evidence now of a growing user community, one which is within both the Federal Government and State and local governments, as well as within the private sector.

We just haven't totaled the numbers yet. That is the only real question in my mind. When we look at the forecasting effort of the Department of Agriculture and how that effort is maturing and advancing and the economic return on that effort, the spinoff from it, as well as the interested groups in a variety of natural-resource explorations, land-use management, other efforts like that, we know the market is very large.

How do we get information to that market at a reasonable price and in a reasonable condition to be used?

Dr. LUKASIK. We do not know what the price elasticity of the market is. At this time earth resources data are virtually free. The user pays reproduction costs but obviously he is not paying a price which is cost-related in any economic sense. There is a great demand for the data. What happens if one has to pay the entire cost, including the amortization of the facilities and the development of new facilities? The data could become quite expensive under such a circumstance and then it is not known what the

market then would be. It may be a business that the Government would simply have to subsidize more along the lines of S. 663.

Senator SCHMITT. Well, we are certainly not going to find out unless we test it.

Dr. LUKASIK. I agree.

Senator SCHMITT. We will have a number of questions for the record which will tap the general regulatory experience of the FCC in this area.

Do you feel, that there are major constraints, and if so, what are they, that discourage the private sector from developing an earth resources operation system other than the ones you just described? Uncertainty is clearly there. Are there any other structural constraints or institutional constraint? The fear that, say, the Federal Government would not remain as a major purchaser?

Dr. LUKASIK. Well, I think there are questions of the degree to which the Government would buy this information. Since the Government is a very large part of the market, that has to be a major market uncertainty. I would think a second issue would be the degree to which the Government might not eventually compete with a private organization. Government is continually launching spacecraft for various purposes. The degree to which there might be some particular Government needs that would be better met either by a new satellite system or by add-ons to other satellites, especially as one gets into the late 1980's where the Space Transportation System will be in full operation, is unknown.

It could be that there will be other technical approaches perhaps involving large space structures or some other technological developments that will render the single mission spacecraft approach less desirable. As we are able to put larger payloads into space and evolve multifunction systems, one really does not know how the technologies will play together and thus in turn, how various financing arrangements will work.

So I would say that the world is approaching an era of major change in space operations and how things will be in the 1990's is hard to predict at this time.

I would say there is at least as much technological uncertainty, as well as technological risk, in addition to the market uncertainties we have discussed already.

Senator SCHMITT. Because of those considerations, do you think a private corporation of this kind, as envisioned in S. 875, should have special depreciation considerations so that the amortization schedule is not a constraint in the development of new technology?

Dr. LUKASIK. I think one would want to pay particular attention to that aspect of the corporation. I think the technologies are changing rapidly and one would not want to tie the corporation to a technology beyond the point of its economically effective utility.

Senator SCHMITT. Is there anything in the FCC experience you are aware of that would help the committee in defining the boundaries between data, preprocessed data and processed data? Knowing where to define the beginning of a competitive environment versus that which is a monopolistic, at least in structure has been a difficulty for all of us.

Dr. LUKASIK. Well, as you know, there are two developments that are perhaps relevant. One is the notion of an underlying carrier

that provides raw transmission services and then the ability of private organizations to purchase a part of that capacity, add value to it, and then resell that capacity. That is something that the FCC has noted starting in the early 1970's when such value-added networks first came into existence, and we have responded to it.

This is a case where adding value is recognized by the FCC as not being a regulated function. It is only regulated to the extent the organization, if it is a regulated organization that is undertaking such an activity, is required to establish a separate subsidiary with which it deals in arm's-length relationships.

The second part of our experience is perhaps not as helpful. That is the continued difficulty that the FCC has in its computer inquiries in defining the boundary between communications and computing. Communication is recognized as something for which there is reason for undertaking regulation while the computer and data processing business is a free enterprise activity, that needs no regulation and is better left unregulated.

To date the FCC has not been successful in achieving a useful definition separating the two. In the case of the earth resources information, there will be something like this but I think the task will be easier. The raw data from the satellite is recorded but it is not particularly useful to a user in its original form. It has to be edited, formatted, and analyzed in various ways. I think that the separation of raw data from the spacecraft and processed data, value-added data, will be easier to define in this case.

Senator SCHMITT. It may or may not be. We had difficulties in doing that. The question of just computer capability, developing computer capability between the data and whatever other potential user there is, that is a matter of processing.

As a matter of fact, I think as we get more and more capability to collect information from space or in space, we will be preprocessing before we ever transmit it, in order to keep control of the amount of data that can be collected.

Dr. LUKASIK. I could still argue that the first receipt of the data on the ground represents the fundamental collection and everything that has preceded it is part of the space system.

Where there could be difficulties, I think, are not so much in the preprocessing of data in space but rather relating to the timeliness of the data. When you collect data and put into a computer memory and accessed it days or weeks later for whatever economic purpose it serves, you have one kind of information system.

On the other hand, there are many applications where timeliness of the data is key, whether it is a response to flooding or other natural disaster, rapid evaluation of crops for market forecasting purposes, or concern about the location of icebergs. Meeting these kinds of requirements are apt to be more expensive; perhaps one has to target the system in a time critical fashion. One has to put processing priorities on data, and that can increase the system cost. Thus cases like these can blur the boundary between the user and the collection system for the relation between the two is an interactive one.

But if these cases represent only a small part of the market demand, then it is likely to be only a small part of the total economic value of the system and hence may not be a serious

problem. But if it is a major use of the system, that could confuse the boundary between the regulated and unregulated activities.

Senator SCHMITT. We appreciate your testimony. It has been very helpful.

[The statement follows:]

STATEMENT OF STEPHEN J. LUKASIK, CHIEF SCIENTIST, FEDERAL COMMUNICATIONS COMMISSION

INTRODUCTION

Mr. Chairman and members of the Subcommittee, I am pleased to have this opportunity to present my views on the two bills, S. 663 and S. 875 dealing with the provision of earth resources information from an operational remote sensing satellite system. While the specifics of remote sensing of the earth from space-based and other platforms are relatively distant from the communications policy issues dealt with by the Federal Communications Commission, such systems do raise a number of regulatory issues with which the Commission is familiar. These are outlined in S. 875 Sec. 201(c). They include insuring effective competition in the provision of the information service; insuring nondiscriminatory access to the information at just and reasonable prices and specifying other terms and conditions; prescribing accounting regulations and ratemaking procedures; prescribing standards of quality; insuring the development of improvements in the service; and insuring that additions to the facilities of the service are limited to those required by the public interest, convenience, and necessity.

S. 875 proposes to establish an Earth Resources Information Corporation that would be regulated by the FCC to accomplish these objectives. S. 663 instead proposes an Earth Data and Information Service within the National Aeronautics and Space Administration. The bulk of my remarks will address S. 875 and will be based on the FCC's experience in regulating public and private organizations engaged in the comparably high technology area of terrestrial and spacebased communications. Also, as requested by Senator Schmitt, I will address the specific question of the FCC's experience in regulating Comsat for such light as that may shed on the regulation of an Earth Resources Information Corporation.

MONOPOLY SERVICES AND THE ROLE OF COMPETITION

The FCC deals, of course, with the regulation of monopoly or near-monopoly services and carriers. With the introduction of competition into telecommunications services and equipment the FCC has also had to deal with issues of nondiscriminatory access to monopoly facilities, cross-subsidization of competitive services by monopoly carriers, and the avoidance of harm to national networks from interconnection of incompatible devices. In addition, as manager of the electromagnetic spectrum for non-government uses, the FCC is responsible for preventing unwarranted interference among competing uses of the spectrum. Nevertheless, the solution to these problems in this country, unlike that in many countries where virtually the entire communications establishment is state-owned, is to restrict the regulatory functions to the minimum necessary and to provide for the greatest possible role for competition and private enterprise.

Thus the FCC plays a major role in the regulation of the large monopoly common carriers. It focuses on quality of service, conditions of ownership and equity of access in the broadcasting area. It restricts itself to spectrum allocation, spectrum assignment, and the approval of new communication services in other regions of the spectrum. In all services it assures freedom from electromagnetic interference. But it leaves the ownership of facilities, the manufacture of equipment, the development of new technologies and innovative communication services, and the provision of programming and its distribution in private hands. This approach has worked well in the communications area and we suggest the adoption of as many of these principles as appropriate for the coming earth resources information industry. In particular, we would suggest the control of the natural monopoly aspects of the earth resources information industry, especially as they impact on equity of access to the basic information; the limitation of large capital facilities to those required for the public interest, convenience, and necessity; and insuring standards of quality and the development of improved data collection. These would appear to relate to the space-based sensor platforms and their associated ground control and data recording facilities especially.

Once the basic data have been collected by the satellite, however, their packaging and distribution for individual users would appear to benefit most from the market

interplay of competitive forces. There are a variety of functions to be performed after data collection ranging from simple data searches and formatting data for individual users to analysis of the data to answer specific questions, ground and aerial surveys to establish ground truth, and the like. These can be done by many organizations of varying background and skills, large and small, new and old, domestic and foreign.

RATE-OF-RETURN REGULATION

S. 875 recognizes the fundamental natural monopoly aspects involved in remote sensing of the Earth by establishing a single rate-of-return regulated corporation to provide an Earth resources information service. On the basis of our experience with the communications industry, we believe that rate-of-return monopoly regulation is not the most desirable approach to take in dealing with the public good aspects of collecting and transmitting earth resource data from space. We feel this because rate-of-return regulation tends to create incentives for the regulated firm to incur higher costs than necessary in the short run, and over the long run to retard the introduction of lower cost technology, thus maintaining higher costs.

Since rate-of-return regulation limits the firm's profits to a given percentage of its invested capital, the regulated firm can only increase its profits by increasing its capital investment or rate base. Thus, the firm has incentives to expand its rate base both by extensive use of capital and increasing the total size of its business. Faced with these incentives, the firm is likely to adopt more capital-intensive techniques than those that would produce its output at lowest cost, including capitalizing any expenses allowed by the regulatory agency.

These same incentives often lead a regulated firm to establish long depreciation lives for its equipment. The more slowly equipment is depreciated, the longer it remains in the rate base and earns the allowed rate of return. In periods of rapid technological change, long depreciation periods can limit the regulated firm's ability to adopt new technologies. A relative overabundance of long-lived plant and equipment that has not been fully recovered leaves the regulated firm unable to replace it with new technology rapidly.

In principle, the power to require prior authorization for facilities, which S. 875 would confer on the Commission, gives the regulatory agency the ability to review whether or not the firm is adopting excessively capital-intensive techniques. Presumably, the regulatory agency can refuse to allow any facilities that unnecessarily raise costs, thereby avoiding many of the problems referred to. In reality, a regulatory agency is not in a position to know the underlying technology better than the firm or firms it regulates and thus it is often unable to judge whether expenditures are necessary or reasonable. This would be especially true in the case of regulation of the proposed Earth resources information service, for with only one firm in the business the Commission would be unable to compare its costs and performance with other firms.

A remaining problem of rate-of-return regulation is the cost of the process itself. Regulatory agencies given similar powers to those in S. 875 become embroiled in numerous disputes with the firms they regulate over questions such as those involving what is an appropriate rate-of-return, what expenses should be allowed, what assets are appropriately included in the rate base, and what is the appropriate rate of depreciation. These controversies consume many of the regulators' resources, which must be paid for by the taxpayers. They also consume the resources of the regulated firm, which increases its costs, costs which must ultimately be paid by the ratepayer.

Thus, while I grant the need to control the natural monopoly aspects of an earth resources information system, I would suggest that for at least two reasons the rate-of-return regulation of a vertically integrated private corporation as proposed in S. 875 will not in the end be satisfactory. First, this is so because the monopoly aspect of the data collection need not be inextricably linked to the distribution of service aspects that will benefit from the greatest possible competition. And second, rate-of-return regulation establishes perverse incentives for the monopoly firm, aggravated in this case by the likelihood of a single collection system.

GOVERNMENT OWNERSHIP AND OPERATION

S. 663 proposes a totally different option, whereby the government provides the natural monopoly aspects of the Earth resources information service. Under this option NASA would design, procure, launch and maintain the spacecraft, monitor the Earth, and transmit data to the Earth. Any user would have equal access to these data presumably at charges that would cover the Government's cost in obtaining them. While this approach would have the advantage of avoiding the problems

of rate-of-return regulation, it too has certain flaws. First, like S. 875 it would allow a single totally integrated organization to control the collection, transmission, processing, and distribution of earth resources information to users. Thus it too couples unnecessarily the monopoly space facilities for collection with the more desirable free market aspects of analysis and distribution. While Section 7 of S. 663 would allow for various industrial, commercial, not-for-profit, and government organizations to be involved in virtually all aspects of the operation of the earth resources information system, it would appear that they would operate in the current manner of the NASA government/industry/academic team. Unquestionably this has been spectacularly successful since the establishment of NASA in 1959. But those successes have been research and development successes, not the operation of a viable economic enterprise. And inevitably one must ask if such a government enterprise would in the long run remain innovative and responsive to user needs.

AN ORGANIZATIONAL ALTERNATIVE

Building on the preceding discussion, it would appear that a private sector alternative to the totally-regulated private corporation proposed in S. 875 exists. This would be to preserve the desirable aspects of private ownership in terms of responsiveness to user needs by allowing users the option of owning proportionate shares in the Earth resources information system. The fundamental concept is that users could be protected against monopoly charges by having the right to buy into the monopoly facilities according to their proportionate use of the system. Clearly, if users have a share in the profits proportionate to their contribution to the revenues collected, they will on net be paying cost-based prices. Indeed, users may not even have to exercise their option to buy into the system, as the existence of the option alone may cause non-user owners to price services in a cost-based fashion.

Obviously every small user of earth resources information cannot be expected to be able to or desire to buy ownership shares in the Earth Resources Information Corporation. What is envisioned is large users of such data, consortia of users, and possibly "wholesalers" of data owning proportionate shares. Small users should be protected because if they were being charged prices above the costs of serving them, it would be profitable for new user organizations to buy into the system and provide information to them at a lower price. By periodically revising ownership shares according to current use of the system, competition to own the system can be expected to keep prices to end users at competitive levels. Similar mechanisms exist for deep water ports and have been discussed for the ownership of international telecommunications facilities.

This mechanism works to avoid exploitation of monopoly power to the extent that users can buy ownership shares at a competitive price. Therefore, if this option is selected, the Earth resources information service should provide open ownership to all users at a price equivalent to replacement cost less economic depreciation. In addition, open and non-discriminatory access to the data provided by the system should be provided to all users, owner and non-owner alike. Once resources data have been transmitted to the earth, the processing and distribution of those data are competitive, not natural monopoly, activities. Thus, access to the raw data should be open and non-discriminatory. It may be desirable to establish a separate arms-length subsidiary of the Corporation for processing and distribution to insure that these activities will be competitive. In addition, numerous analysis and professional service organizations exist or are likely to be established to meet the new market needs that will arise.

The primary advantage of this proposal is that it allows private enterprise to provide the service, but with an effective non-regulatory constraint on its ability to charge users monopoly prices. With users able to buy into the system if they feel they are being charged excessive prices, it no longer is necessary for the Commission to review the system's prices or practices. Likewise, by not imposing a rate-of-return constraint on the service, there is no need for the Commission to review the facilities acquisitions of the Corporation. The Corporation will have the incentive to offer services at least cost and to seek out competitive prices for the equipment and services it buys.

At the same time, as a private corporation, owned at least in part by its users, the Earth resources information service can be expected to be responsive to user needs. Providing unwanted services will decrease its profits; reducing costs and providing desired services will increase its profits. Subjecting the information service to market pressures should result in desirable levels of performance.

Another useful aspect of this proposal is that it would encourage the proposed private unregulated corporation to deal in a natural way with existing communications carriers for their services in lieu of constructing separate facilities. While uplinks and downlinks are integrally related to spacecraft operation and data

acquisition, intersatellite links, terrestrial point-to-point services, and data processing and transmission functions can all be provided by existing markets. For while it is not the corporation's primary business, communications will play a vital role in its operation. Each satellite placed in orbit will require radio channels for command, tracking, and housekeeping purposes. Other channels will be needed for interrogation of ground-based, data-gathering platforms from the satellites. Wideband channels will be required for the transmission of data to earth stations. And if active microwave radar sensors are used, as on the SEASAT and the proposed NOSS satellites, additional frequencies in several bands will be needed.

Due to the limited amount of spectrum available in the present usable range, many of the frequencies required will have to be shared with other services in the United States and other countries. These include other satellite services and terrestrial systems—both government and nongovernment. Both transmitting and receiving earth stations will have to be coordinated nationally and internationally with those users of spectrum potentially affected.

It may be necessary to allocate or reallocate new frequency bands to accommodate this service. Appropriate rules, licensing procedures, and technical standards would be established through the FCC's regular rulemaking processes. Thus, to this limited extent, the FCC will contribute to this important undertaking.

FCC EXPERIENCE IN REGULATING COMSAT

The Communications Satellite Act of 1962 makes Comsat the sole U.S. participant in the global commercial communications system, Intelsat. The recently enacted International Maritime Satellite Telecommunications Act gives Comsat the additional responsibility as the sole U.S. participant in Inmarsat, an international consortium of nations created to establish a global maritime satellite system. In view of this additional responsibility, Section 505 of the International Maritime Satellite Telecommunications Act directs the Commission to conduct a study of Comsat's corporate structure and operating activities to determine whether any changes are required to ensure that Comsat is able to fulfill its obligations and carry out its responsibilities under the Communications Satellite Act and the Communications Act of 1934. This study is currently in process and we expect to issue a report to Congress by May 1, 1980. Thus, the views I express today regarding the Commission's experience in regulating Comsat must be considered tentative, pending completion of the on-going study.

Under the Communications Satellite Act of 1962, the FCC has the responsibility to regulate Comsat, an organization whose activities are based on high technology space systems of the sort envisaged for the Earth Resources Information Corporation proposed in S. 875.

As an independent regulatory agency, the FCC generally exercises jurisdiction over satellite communications services to insure that such services are made as widely available as possible to U.S. consumers and that the limited resources of spectrum and orbit allocated for non-government satellite communications are used as efficiently as possible. While the Earth Resources Information Corporation would be established along lines similar to Comsat, because it would provide information services instead of communications services, the Commission's experience in regulating Comsat may not be entirely relevant in considering S. 875. Nevertheless, certain aspects of the experience may be helpful.

1. *Participation in Intelsat.*—The Satellite Act authorizes Comsat to establish a global satellite communications system in conjunction with foreign countries. S. 875 similarly empowers the Earth Resources Information Corporation to plan, initiate, construct, own, manage, and operate a commercial Earth resources information service by itself or "in conjunction with foreign governments or their designated entities." This implies that the ERIC may participate in an international cooperative venture like Intelsat in order to carry out the purposes of the bill. In such case, it would be necessary for regulatory and Executive Branch agencies having oversight responsibilities over ERIC to enter into arrangements to coordinate regulation of ERIC's participation in the venture. The FCC experience with Comsat shows that such arrangements are necessary in order to assure that its activities as a member of Intelsat are consistent with the objectives of the Satellite Act and United States foreign policy and national interests. The arrangements that now exist for oversight of Comsat's participation in Intelsat set forth in the process by which the FCC, the Department of State, and the National Telecommunications and Information Administration coordinate their efforts in issuing instructions to Comsat, concerning matters that arise in Intelsat and fall within the parameters of the oversight responsibility given to these agencies under the Satellite Act.

2. *Authorization of satellite facilities.*—The Satellite Act makes Comsat subject to the licensing provisions of Titles II and III of the Communications Act of 1934, 47

U.S.C. 151 (1971). These provisions require Comsat, to obtain FCC authorization for participation in the construction and operation of an Intelsat satellite facility, construction of earth stations and establishment of lines of communication between particular geographic points. S. 875 does not specifically make ERIC subject to the FCC's licensing powers under the Communications Act, although it mandates the FCC to insure that no substantial facility additions are made by ERIC not required by the public interest, convenience and necessity and empowers the FCC to require ERIC to make facility additions that would serve the public interest, convenience and necessity. Since the earth resources information service contemplated by S. 875 would apparently involve use of non-government frequencies, the FCC would require appropriate licensing authority over the construction and operation of satellite facilities and earth stations by ERIC in order to insure proper coordination of frequency use and selection of orbital locations.

3. *Regulation of rates for satellite channels.*—Under the Satellite Act, the Commission regulates Comsat's rates for the satellite communications channels it provides to U.S. communications common carriers and other authorized entities. S. 875 would charge the FCC with regulating ERIC's rates for information services rather than communications services. In addition, the bill would require the FCC to insure the complete and unabridged distribution of information, prescribe standards for quality for information and set schedules for the corporation's fulfillment of data requests. While communications is an increasingly important factor in the provision of new and varied "information services," our experience in regulation of Comsat's rates for communications services may not provide a precisely transferable body of knowledge useful in this new context. On the other hand, to the extent that the Congress determines that ERIC's rates should be cost-based and the system uses essentially similar satellite technology which the Commission is familiar with, the FCC might be in a position to employ rate making methodologies developed in the context of telecommunications.

4. *Equipment procurement.*—S. 875 directs the FCC to insure effective competition in the procurement by the Corporation of apparatus, equipment, and services required for the establishment of the Earth resources information service. The Satellite Act contains a similar directive with respect to procurement by Comsat. The provision in the Satellite Act is intended to prevent favored treatment from being given with respect to supplying equipment and services for the global system. The FCC has implemented the provision by adopting specific rules and regulations regarding procurement by Comsat for the global system and earth terminal stations. Implementation of the directive in S. 875 would likely require adoption of similar rules and regulations.

In the regulation of Comsat the Commission has encountered two problem areas that may be relevant to the proposed Earth Resources Information Corporation. Based on a variety of uncertainties regarding the feasibility of its technology as well as the extent of the eventual use of its system, Comsat initially pursued a financing plan which resulted in what is now believed to be, for rate making purposes, a disproportionately expensive capital structure.

This problem was ultimately resolved by the FCC in a recent Settlement Agreement arising out of an extended rate case. The settlement agreement establishes a gradual prospective phase-in of imputed debt. The problem could, however, reoccur with respect to ERIC if appropriate oversight authority over ERIC's capital structure is not given to an appropriate regulatory agency. S. 875 contains a provision applicable to ERIC similar to that in the Satellite Act which empowers the FCC to approve or disapprove any future issuance of stocks or borrowings by Comsat. It should be noted that the FCC has never has the opportunity to invoke this authority since Comsat has never chosen to issue more stock. The Congress may thus wish to consider empowering any regulatory agency charged with ensuring the reasonableness of ERIC's rates with the discretion to order changes, under appropriate procedural safeguards, to the capital structure of the firm to respond to changed circumstances.

The second area which has drawn governmental attention concerns Comsat's entry into activities outside the statutory mandate. The Satellite Act does not place parameters on or otherwise impose specific limitations on the activities in which Comsat is allowed to engage. Comsat has been and is looking for business opportunities involving activities outside its original role as the U.S. designated representative in international communications. The FCC has permitted Comsat to enter the domestic and maritime satellite operations. In doing so, it required Comsat to form a separate subsidiary to engage in any domestic satellite venture and other non-Intelsat related activities. This had the dual purpose of (1) guarding against potential conflicts of interest resulting from Comsat's peculiar ownership structure, e.g., the fact that Comsat might compete against some of the carriers which then held its

stock, and (2) assuring that Comsat would, at all times, retain sufficient funds and financial capacity to discharge fully the responsibilities imposed on it by the Satellite Act as the chosen instrument of the United States in the global system. The FCC determined that the establishment of such a subsidiary should be supported by a plan providing for the financial independence and viability of the subsidiary as well as establishing definitive limits on the amount of investment to be made by Comsat in the subsidiary and on the liabilities Comsat could assume with respect to the new corporation.

Since establishment of the separate subsidiary under the FCC's conditions, however, Comsat has been and is becoming involved in a number of unregulated activities.

Of particular interest with respect to S. 875 is Comsat's entry into the environmental information services field through the recent acquisition of Environmental Research and Technology, Inc. (ERT). ERT is engaged in a broad spectrum of environmental services intended to assist customers in complying with federal and state environmental standards and regulations in a cost-effective manner. These services include environmental monitoring, analysis and prediction services, and environmental and ecological consulting services. Comsat intends to apply satellite communications technology toward the development of new environmental data collection, monitoring, and analysis services by ERT. This endeavor will involve the expansion of ERT's operations by establishing a sophisticated environmental monitoring and data network using satellites for the transmission of information.

The direction Comsat is taking in expanding into unregulated activities may raise potential conflict of interest and cross-subsidization problems. It has been alleged by some that Comsat's statutory obligations and responsibilities under the Satellite Act could be compromised if Comsat's corporate financial interest in its non-regulated activities conflicts with those obligations and responsibilities. In addition, it has been said that a danger exists that Comsat can use its monopoly position as the sole supplier of international satellite communications to subsidize its competitive activities which are not regulated. Since S. 875 does not place parameters on or otherwise impose specific limitations on the activities in which ERIC may engage, Congress may want to consider specifying the activities and the corporate structure of ERIC as guidance for possible future diversification of its activities.

CONCLUSIONS

From the foregoing, Mr. Chairman, it is clear that my recommendation, based on a study of the FCC's forty-five years of regulatory experience, is to proceed cautiously with the creation of a corporation that will require extensive government intervention to assure its continued operation. We at the FCC have undertaken numerous steps and we are recommending still further steps that will reduce our past detailed governmental intervention in the communications industry. We have virtually eliminated our supervision of the local TV cable system franchising process. We have proposed to further deregulate the cable TV industry, and we are also studying how to reduce our role in radio broadcasting in a responsible manner. We have introduced simplified licensing procedures and we have proposed market alternatives to comparative hearings for spectrum assignment and to administrative rule making for spectrum allocation. We are studying satellite earth station delicensing and procompetitive moves in the telephone and telegraph industries.

Our experience has led me to believe that innovative services at the lowest possible cost result from the free play of competitive forces in the market place. While every market has its own unique characteristics, and those of a new earth resources information industry cannot be foretold at this time, our advice would be to go as far as possible without involving unnecessary regulations. For it is likely to be easier to correct inequities by subsequent legislative redress than it is to risk either excessive regulation of a fledgling enterprise or to have to go through the painful regulatory withdrawal process.

Nevertheless, should this subcommittee choose to report out a bill along the lines of S. 875, I would respectfully suggest that such regulatory oversight as found to be required be sought elsewhere within the Federal establishment. The FCC's existing responsibilities for our national communications system are too important to be deflected to this new function however meritorious its promise. For example, both the U.S. Geological Survey in the Department of the Interior and the National Oceanographic and Atmospheric Administration in the Department of Commerce have long term experience with the operation of satellite systems and the utilization of satellite-derived data for geophysical investigations. Certainly a partnership of these organizations with NASA could provide for the effective management or control of a private organization for the provision of earth resource information.

Adequate contractual mechanisms exist to effect the needed organizational linkages. The Congress can itself maintain an oversight role by means of the authoriza-

tion and appropriation process. The distribution of earth resource information to state and local governments can be met by any of the several mechanisms I have discussed above.

The institutions and managerial richness of the U.S. provides a wide variety of alternatives and opportunities to capitalize on our past investments in space science and technology. But I believe that the capabilities and resources of the Federal Communications Commission are more likely to be most effectively employed for the public good in the area that has been our traditional concern.

Thank you, Mr. Chairman.

Senator SCHMITT. Our next witness is Dr. Klaus Heiss from Econ, Inc. Welcome back to the committee. If you wish to summarize your testimony, your statement will be included in the record.

STATEMENT OF DR. KLAUS HEISS, ECON, INC.

Dr. HEISS. Thank you very much for the opportunity to appear before you and testify as to the respective merits of both bills introduced, one by you and one by Senator Stevenson.

First let me state the crucial importance I attach to both initiatives, to see the United States move off dead center in the long discussed question as to whether or not to establish an operational Earth data and information system (EDIS). It is an initiative long overdue.

It is a telling sign of the times that two Senators have to take such inspired leadership in the area of increasing importance to the United States in the 1980's and 1990's.

My perception of the urgency of this initiative is based, one, on the economic opportunities; two, on the increasingly strong initiatives by other countries and regions to move in this area; and, three, the great furtherance that I see coming from any strong commitment to an operational EDIS for the full development of the user community.

Second, aside from the strong common purpose of both bills to bring about an operational EDIS, both bills have strengths and weaknesses which I believe can be reconciled by combining the two initiatives into a single joint initiative.

This marriage of the two bills can be achieved by, first, translating the initiative as proposed in S. 663 into an identical initiative but in the form of a Government corporation along the lines of the Intelsat model, under the aegis of the NASA and in cooperation with industry for the startup or entering period.

Personnel for this enterprise should principally be drawn from industry with a view toward the next recommended step, namely mandating this corporation to go public no later than the interim period and sooner if the Executive or Congress determine the feasibility of such public offering sooner than that.

The transformation of the Government corporation into a publicly owned corporation could also occur automatically by statute whenever the corporation reaches a breakeven point in terms of total cost recovery for providing its services.

The proposed ideas and considerations by Comsat Corporation deserve very careful attention in this context. I reference this in my testimony.

The following are the key criteria that lead me to recommend a combination of the respective strengths of the two proposed initiatives:

(1) ABILITY TO DEVELOP AN AGGREGATE MARKET

The market for Earth data and information services is diffuse, widespread, ill-defined, uncertain and in many areas yet totally undeveloped.

The challenge to put Earth data and information services to direct and most effective use is a tremendous challenge in view of this wide-ranging, undefined market.

I know of no single Government enterprise that ever has or ever will accomplish such an ill-defined, diffuse function effectively.

This is not a criticism of Government nor a blind advocacy of private enterprise. It is simply an observation of the fact that in areas of advanced technology and innovation again and again innovative concepts in a market context have been used and were brought about by private corporate initiative.

Most other nations choose the corporate approach in pursuit of economic matters and matters of innovation and implementation.

The United States, in the early history of its space program after considerable debate and deliberation, also chose the corporate approach in the form of Comsat Corporation to bring about space communications.

In the case of Earth data and information services, a corporate approach with corporate decision processes outside the requirements, rules, operations, and uses of Government agencies and, for that matter, the U.S. Congress, seems to be required to bring about expeditious aggregation of this market and to assure its full development.

(2) ACCOUNTABILITY

Whichever institutional form is chosen for Earth data and information services, the foremost criterion has to be accountability for funds collected and expended; the visibility of the funds committed and invested, as well as the return that these activities are able to obtain from industry, public agencies, private and foreign users, is very important to determine in some form the success or failure of Earth data and information services during operations.

As a side remark let me point out that if one goes back over the past 15 or 20 years to determine how much the U.S. Government already has spent in these areas, it is very difficult to pin down that number, but it exceeds billions of dollars.

Such accountability seems to be much better insured in a Government or private corporate approach than within the budgetary intricacies of any Government agency.

Certainly the urgent pressure to generate and develop additional markets in order to recover funds necessary for operations and further development of the Earth data and information services is totally different in a self-contained, that is, corporate approach than in a Government agency approach.

The major strength of S. 663 and the major weakness of S. 875 at this time are the financing funding requirements of Earth data and information services on one side and the need and desire as well as the public requirement to disseminate such information as widely as possible for its most effective, beneficial public use.

In this context a clear distinction between benefits and value of information on one side, and the ability or the requirement to generate revenues from information in markets is important.

This aspect of EDIS, by the way, is quite different from communication services.

The value of information as to, for example, worldwide crop developments is indeed a tremendous value to markets, consumers and many intermediaries. Yet once a single table of worldwide accurate crop estimates is arrived at, say at the expenditure of many millions of dollars, it only takes 10 cents to reproduce that table of statistics.

Two issues are raised thereby: One, the impossibility to capture through revenues some of the value of the information generated since it is very difficult to exclude people who didn't pay for the full cost of the information from the use of that information.

No statute by this Government or any other government can prevent the dissemination and/or reproduction of intrinsically very valuable information such as crop statistics, nor should it be prevented.

Two, it is not in the public interest to have such information closely held by a few, be it the Government or be it a few private institutions.

This is explicitly recognized in the United States by allocating very substantial agricultural information functions to the USDA.

Similar examples as to the difference between the value of information and the ability or desirability to have revenues generated from such value can be given in many other areas of EDIS.

This does not mean that sizable, significant revenues cannot be generated by such data and services provided to a variety of user groups. However, particularly in the initial phases, the desirability to recover total cost nor the ability to do so with the preservation of the public good aspects of information—that is, the widest possible dissemination of information to all users—seems to be easily reconcilable.

After an initial period such recovery of funds can be assured. During this interim period it may be determined that the public interest as well as the institutional data and information provided require continued expenditure of public funds in direct support of such services.

In the rest of the prepared statement—I also point out that I don't believe that special statutory provisions for the prohibition of the reproduction of this information are needed nor desired.

It is a bad mistake to create here a new monopoly to provide against the dissemination of information. Either existing copyright laws and laws dealing with information suffice, and they should suffice in this area, or they don't, and should be dealt with by appropriate general statutes.

You don't assure a recovery of funds by creating an artificial and unenforceable monopoly on information gathered from space.

In addition, it is not in the interest of the United States to have such a provision in the bill. It would unduly restrict U.S. corporations and does nothing to prevent foreign corporations from the full use of that information.

In the prepared statement I go further and elaborate on all the themes I just mentioned—marketing aggregation, accountability for funds expended, accountability as to ability to raise funds, and also accountability as to management.

Let me expand on that last point somewhat. It is quite important for the successful implication of any new venture to clearly know who is in charge, who can make decisions, who will implement decisions, and will these decisions stand.

In the current structure of Government, and also in the proposed structure of the decisionmaking process for EDIS under S. 663, the lines of responsibility go from the manager of EDIS to the Administrator of NASA to the President and to the Congress with essentially unpredictable uncertainties all along this route of command.

Most important, decisions concerning EDIS are reserved in S. 663 to the Administrator of NASA rather than the general manager of EDIS. The judgments may differ. Whichever decision and request is carried forward by the Administrator may not be sustained at the presidential level by the Department of State or other branches of the executive, and may be severely interfered with by Congress.

One great difficulty today, only partially alleviated by S. 663, is to find out who is the decisionmaker on EDIS-related private initiatives in Government. Many officials can interfere adversely, but no one official can see a proposed private venture through to success on behalf of the Government.

Finally, as to the issue of national security, I think that issue does not exist with regard to the information and data services to be provided in both initiatives.

As to high resolution levels later on, I again don't see how national security would be adversely affected.

I want to submit that an initiative taken in France about 12 months ago would expand making available very high resolution observations through some appropriate international setup to all countries in pursuit of further disarmament. I think those are true, positive national security issues and opportunities.

Improved information is stabilizing. However, this issue is simply not raised by the type of information to be provided under either of the two bills. Hence that should not be decisive in deciding for or against a corporation versus Government agency approach on this issue.

That concludes my prepared remarks.

Senator SCHMITT. Thank you, Dr. Heiss.

Almost an infinite number of questions come to mind. Your testimony is much more detailed than you have presented in your summary. It will be extremely valuable in trying to structure a bill that combines the best aspects of the two approaches with a transition period that will work.

With respect to that, you indicate a preference to begin with an operational Earth data information system to be located for a 5- to 7-year period within the Federal Government and then spun off into a private sector operation.

You are as aware as anybody of the tendency of a government agency to retain its jurisdiction and to spin off only with great difficulty.

One reason Comsat was successful was we didn't allow that to happen. We said create it and make it work after we created it.

Do you see any way to insure that such spinoff does occur?

Dr. HEISS. Not if it initially is not mandated by statute.

Senator SCHMITT. Statutes can change, unfortunately.

Dr. HEISS. Make it difficult in the statute. Maybe even that can't be done. I agree with the thrust of your observations. The difficulty I see, which I think can be overcome based on the Intelsat example, is that the corporation will require initially direct allocation of Government funds.

The way the corporation is structured should be done constructively. It should not be bogged down in accounting issues. One has to take an innovative approach and realize that the resources that have been sunk are sunk and make the best of the current and future opportunities.

For example, one could turn to a private user-based corporate approach down to preprocessed data. Any activity beyond that should be open competition. Initially, the Government contributions to this entity may amount to 70 percent, say, of the needed annual funds, which annual funds are stated in the enabling legislation. Then over a 5- to 10-year period the Federal contribution to run these operations would decrease from the initial 70 percent, say, to 30 percent, stated again also in absolute dollars.

The 30-percent investment would be made, for example, to maintain through this corporation an archive and data bank for research purposes; 30 percent of such costs of the total operations would easily be justified by the value of such an archival data bank for future generations of research use.

Federal user agencies should make evaluations on their own through their budgetary processes. The direct Federal contribution should not preempt nor be seen as a contribution to, for example, having the Department of Agriculture buy services, in this case subsidized, from this entity.

Any services the corporation will provide to other Government agencies should be based on principles of accountability. Thus: does the agency want the services? Can it afford these activities out of existing budgets? Are added agency budget requests needed?

The decreasing direct Federal contributions may from 70 percent to 30 percent over time will set up competitive mechanisms and pressures on the corporation to proof performance, to raise funds in the market, including Federal agencies, to develop domestic users and foreign users. Incentives can be combined with that ability by the corporation to do so, may in the rate of return on investment allowed to the corporation. That mechanism can be set up.

If done along these lines, such an innovative corporate approach—I know of no precedent—would clearly be sort of a fortuitous marriage between the intent of both bills, assure accountability and ability to aggregate markets with little danger of having the intent of EDIS undercut by future governmental decisions, be they accidental or otherwise—budgetary expediency—to which EDIS within a Government agency would invariably be exposed to.

Accountability goes two ways: to assure operations of a viable entity, and to terminate operations of a wasteful, uneconomic entity. A corporate approach assures this much better than any

Government agency affiliated activity. I would like to draw, for purposes of reference, your attention to a Brookings study appropriately titled: "Are Government Organizations Immortal?" It appeared in 1976.

Mortality rates for Government organizations are orders of magnitudes less than for private institutions. In this context that's very important.

If EDIS is successful, let it survive. If not, a mechanism should be built in to abolish that organization in a corporate approach assures this much better.

You don't want to repeat the expenditures, say, in national security areas where mounds of information are generated and the use of information sometimes is very inadequate.

Senator SCHMITT. Now, you touched on the issue of marketing in an indirect way. A key to growth and a successful transition will be the development of markets for the use of this information, markets that we can anticipate and many, I am sure, that we cannot. Do you see a problem here with the kind of organization that you suggested?

With a governmental corporation, there would be no great incentive to create new and expanded markets in the earlier days when it is so important.

Dr. HEISS. Again, if you embedded this organization within Government, I think that instinct—be used to market aggressively—is reinforced many fold. If you included in the structural reorganization pressures to require that organization to recover funds, and if you use new people, assemble a new team to bring this use about, then I think the chances and requirements for your own survival 5 years hence will make you very imaginative in how to go about developing markets for this information.

Let me give you a maybe, totally inappropriate example: Recently I traveled to Europe on Air France. The Air France menu had fantastic pictures on its cover with extensive explanations on the back side of what these images were. These were Landsat pictures used in fascinating ways showing the destinations as to where the plane flew to, and for all Air France routes.

Why do others—that is, France—have such imagination on topics of such importance with no subsidy—as a matter of fact, using foreign technology, when it comes to making imaginative use, and playful use, of key advances in space?

Clearly, I think in the image of most Air France travelers this was a French satellite system since very few read small footnotes.

But, aside from this light remark, there are just hundreds of incidents you can observe in international symposia on Earth resource data and uses where developing countries come along with imaginative new ideas to adapt their information to their own uses, meetings such as in Manila or Peru, the interest by the People's Republic of China in Landsat-related areas and so on.

You want to set up a corporate structure where you can react on a day's notice without worrying about travel funds or rules, an ability to enter into immediate joint ventures where you think it is profitable, commit funds that you deem are appropriate, use equipment that may not in all cases be U.S.-built but best suited to the task at hand. I do not see how within a Government agency you

get that type of initiative, and also pressure, to be able to recover funds and to perform.

This is important. Particularly since you have uncertainty, so vast market uncertainties, you require not a Government agency but a corporate approach.

Typically where uncertainty exists where you have to create a market the corporate approach is called for. The ability to deal with this made the largest corporations over the past decades.

The ones who missed out on it didn't make it. The ones who picked up on those ideas and translated it into a usable form and created a market made it.

Go back 100 years. The idea of the telephone. When Bell first proposed it to Western Union they thought he was nuts. Then for \$20,000 he formed his own corporation and today A.T. & T. is the largest U.S. corporation, and worldwide.

Take the Xerox process. Take the development of computers under IBM. Again and again it is the approach on how you go about developing markets for new technology. That is the key to success. You have to be innovative. Take risks. Work at it 24 hours a day 7 days a week.

I don't see that happening in the current structure of even NASA, which is quite innovative in many areas.

Also, NASA, who did have a chance to develop its market for 15 years and yet does not have a record to show operational uses of the system may not be the most likely institution to now make a success of it.

The last item: If it is my funds I am risking on an operational system, I will not risk the system with only one satellite in orbit. That happened on Seasat, with no backup capability. It is happening on Landsat. It is not an operationally designed system that entices users to commit their own funds. Yet NASA unfairly is hit by OMB and others not to provide adequate backup or so it seems.

Why are the uses not there? To get rid of a history of laggard enterprise you have to cut the umbilical cord. Probably the time is now. You have to do it in a way that also takes into account the unique sort of aspects of the structure of this problem, that is, the public good aspect of information.

You may not want to require full cost recovery initially for some uses. To do that you need 4, 5, to maybe 10 years of defined, limited, but nevertheless substantial Federal commitment of funds directly.

Senator SCHMITT. When you went through the list on major corporations coming about as a consequence of taking a risk nobody else would take, one risk they did not anticipate was the Justice Department. The whole list is involved in some major anti-trust suits at the present time.

Dr. HEISS. That is a measure of success. I don't think you have to worry about that for a long time.

Senator SCHMITT. The issue of the pace of technology we talked about a bit earlier.

Dr. Heiss, do you see any way in which some of the dire consequences that Dr. Lukasik mentioned will come about? Is there any way we can avoid that?

Even if there is investment, there is the question of how you amortize that plant and any new plant that is created without inhibiting the development of new techniques, technologies, and operations.

Dr. HEISS. I think one has to be imaginative and accountable in the best national interest on your second part of the question. How do you deal with the existing plant and equipment?

Two observations: One, this new entity should not be forced to make use of the existing plant and equipment. It could be a big mistake. It should be up to this new organization to say, well, NASA invested hundreds of millions of dollars but the equipment is not suited for this purpose that I want to achieve.

Two, whatever plant and equipment and other related investments that have been made that are determined by this new organization to be useful for its purpose should be looked upon as a contribution by the Government to start off this operation. I don't think it necessarily should be required of this new entity to recover such past funds, particularly when given the requirement imposed on the corporation to sell some of the information at less than they probably could recover in open markets as to the value of the information generated.

These two considerations might be offsetting. In fact, the initial investment donated to the corporation could be vastly less than the value of the information generated and made available for public use by such a corporation if some of the goals can be achieved like accurate worldwide crop information.

I don't see this as an ideological or even as an accounting issue except that accounting mistakes should be avoided. One should not impose artificial requirements of cost recovery if, at the same time, on the pricing side you don't allow the corporation to recover the full value.

The first question, if I understood it correctly, concerns this inherent fear of technology, which is very deep rooted in literature, as well as in technological developments. Sometimes it is justified.

But here we talk about information. I have observed over the past 10 or 12 years of my involvement in this matter that some people have fear of being told of information. It is just alien to the U.S. structure of society to have such fear override and determine statutes to prevent people from getting information.

Widest possible public information is a principle that we should live by and should make such public information available worldwide. I suspect that some U.S. economists may say we should not make this advanced information available to developing countries because who knows whether they know how to use it. I submit it is up to them to decide whether they can use the information or not. We should assure indiscriminatory equal access to the information. EDIS can assure such access.

Whether that information is good or bad, I don't think is inherently built into the fact that it is gathered by space or on the ground. It is a phony argument in the context of Earth data and information services.

We need information and neither Government nor anybody else should withhold such information if it can be made available. It is just too important on many, many issues of public and private life.

It is important to housewives to know today whether we are being taken advantage of by the Soviet Union in grain deals, which may be withholding information on its own crops.

The workings of the market mechanism increasingly require accurate worldwide information. With such information the market mechanism works.

I have yet to see a farmer not willing to sell a bushel of wheat for a fair price. He is not willing to sell if he thinks somebody is withholding information.

So, in the case of information, I have tremendous difficulties to find any reason anywhere why—by improving it by such orders of magnitude—such information would harm anybody or why we should be afraid of it. There exist other areas of technology where such concerns are justified but not in the case of improved information. That includes national security issues.

Senator SCHMITT. Do you think there is any way to define, if in fact it needs to be defined, the difference between a service that the Government is expected to provide and one that the private sector should provide in a competitive environment? The classic, of course, is weather forecasting. Another example, at least up until recently, is the mail service.

Dr. HEISS. I don't think there exists the need of such a definition. They usually change with changing technology and changing capability.

The correct questions to ask each time—once in a while, maybe every 5 to 10 years—is what services that are provided by the Government, could be more efficiently provided in some other organizational form? And second, also, are there new developments in technology that do require a very active Government role? Again, because of changing circumstances.

For example, as proposed in my prepared statement, one lesson to be learned from the Comsat experience is that the R. & D. role, the innovative role, should be retained by NASA and the Department of Defense. Very often you can observe in industry that once a technology has matured to operational use, in a corporation that entity tends to become rather conservative as to future innovation.

It would be a mistake to preclude the Government from continuing a very active innovative R. & D. role in remote sensing related to EDIS. That is not meant to exclude the EDIS corporation from innovations of its own along cost effectiveness lines. If the corporation can think of a mechanism to provide faster, better, cheaper information, they should do that within their own funds. But the funding of next generation type remote sensing information systems say, using large platforms from geosynchronous orbit, those functions of innovation are very important to the national economy and, hence a Federal role seems advisable. In fact, Federal funding always has played a very important role in R. & D. and it shouldn't be now legislated out for EDIS.

With Comsat, or communications satellite R. & D., we made the mistake in the 1960's of discontinuing NASA R. & D. in that area. We should not repeat it here.

I am not for or against Government or for or against private enterprise in these areas of innovation: The issue is how to orga-

nize this new service to assure accountability and success in aggregating the market. The Intelsat/Comsat example is a useful one.

Senator SCHMITT. You have to be careful. In 1934, we passed the Communications Act and we are just now getting around to recognizing that there are now services that can be competitive. Up until the last few years, they weren't competitive but could have been.

So you can build in that kind of structure, whether you intended to or not. There wasn't the understanding in 1934 of what would happen in communications technology. Once we could see that, more farsighted people saw it decades ago, it still took us decades to finally get down to the business of trying to revise the Communications Act of 1934 so that it is in fact transparent to technology, as I said earlier, and where appropriate competitive services can be provided.

The reason I asked my question was to make sure that, if we possibly can, we avoid that mistake.

Dr. HEISS. Well, I think it is very difficult to define the distinctions for operational uses that really will be involved 20 years from now.

In the Communications Act, you may be in the process of again committing sins along that line. It is difficult to foresee. For that reason, one should not define, regulate and prohibit.

Senator SCHMITT. Let me give you an example of what I can see happening. We have a foreign crop forecasting service provided by the Department of Agriculture. It is becoming more and more dependent on the use of Landsat and other information in order to predict foreign wheat and other crop production. It is getting to be quite remarkable, as a matter of fact, in its ability to accurately forecast crop production.

One of the strangest things I have been involved in is trying to keep that program from being killed in the Appropriations Committee.

Dr. HEISS. You may remember 1973-74.

Senator SCHMITT. Perhaps some private entity, using information available from an operational Earth resources system, will say that if you quit subsidizing the Department of Agriculture, it will provide that service better and cheaper. But it may take 10 years to get the Congress to quit subsidizing the Department of Agriculture.

How do you prevent that from happening? I can almost guarantee that will happen if we are successful in creating an operational resources system.

Dr. HEISS. The corporation has to provide the public service. I think—

Senator SCHMITT. I agree with that now, but I am saying some other entity will say we can provide that more cheaply if you stop throwing taxpayers' money into the Department of Agriculture.

Dr. HEISS. We should look at that assertion carefully and probably follow through by having them live up to what they state. If that indeed is possible and you can assure under the same rules that govern today the release of agricultural information in the corporate setup—and I think you can—with remote sensing information, the statement you just made is much more open to objective, scientific investigation and technical investigation than

today's multifaceted channels of foreign agricultural information are.

That is another positive aspect of this new source of information.

The question you just raised can probably be decided on the merits of the proposition. I think it is inappropriate to subsidize on the Government side crop information using satellites and then have private entities try to compete and come in and enter that market.

Were we to appropriate the funds to this entity then USDA would find it useful and helpful to make continued use of EDIS information. The question is at what price.

By the way, domestically, USDA has continued to be a good source of accurate information as shown in commodity markets. It is just in the foreign area where I think USDA has always been weak. One has to rely on space information and supplementary ground information.

Senator SCHMITT. Were we willing to rely on Lacie in 1976-77? Had we been, we could have made \$3 million for our farmers just on the wheat future prices alone on the predictions for the Russian crop yield.

But we didn't. We got into the market late and sold at a much lower price. Almost 50 cents a bushel less than if we believed Lacie when we first started getting that information.

Dr. HEISS. This is the potential of improved information. It was an experiment. Can you use the results of an experiment for such purposes?

Senator SCHMITT. I would have made the same decision, but I am saying it is obvious now that that potential was there. It is there today.

As a matter of fact, we are going to get a better price because of that forecasting in this time period.

Dr. HEISS. In this connection, I think it is the interest of the Soviet Union to obtain the same information also. This, is another key issue on how you set this up.

While the Soviet Union today does profit tremendously from the monopolistic uses once in a while in commodity markets internationally—you brought up an example, 1972 was another one. Nevertheless, the domestic U.S.S.R. uses of accurate crop information are of such tremendous importance to the Soviet Union that the benefits from having such accurate EDIS information outweighs whatever benefits they have made lately—over the past 10 years—by withholding information.

So, I see a chance for cooperation here rather than confrontation.

Senator SCHMITT. We will have quite a number of questions after we had a chance to analyze your testimony, particularly your prepared statement.

Thank you very much.

[The statement follows:]

STATEMENT OF DR. KLAUS P. HEISS, PRESIDENT, ECON, INC.

Mr. Chairman, Senator Schmitt, members of this committee, thank you very much for the opportunity to appear before you and testify on the respective merits of the bill introduced by you, Mr. Chairman, namely S. 663, the Earth Data and Information Act of 1979 and the bill introduced by Senator Harrison Schmitt, namely S. 875, the Earth Resources Information Corporation Act of 1979.

First, let me state the crucial importance that I attach to both initiatives to see the United States move off dead center on the long discussed question as to whether or not to establish an operational Earth Data and Information system. It is an initiative long overdue. It is a telling sign of the times that two senators have taken such inspired leadership in an area of increasing importance to the United States in the 1980's and 1990's.

My perception of the urgency of this initiative is based (1) on the long time involvement on my side regarding the economic opportunities of such information to the United States and to the world at large, (2) the increasingly strong initiative by other countries and regions to move in this very area of leadership of the United States and (3) the great further advance that I see coming from any strong commitment to an operational EDIS for the full development of the user community in the United States, other nations, and particularly the developing countries. I believe that both bills are inspired by this great perceived opportunity.

Second, aside from the common strong purpose of both bills to bring about an operational EDIS, both bills have strengths and weaknesses which I believe can be reconciled by combining the two initiatives into a single joint initiative. This marriage of the two bills can be achieved by translating the initiative as proposed in S. 663 into an identical initiative but in the form of a government corporation under the aegis of the National Aeronautics and Space Administration and in cooperation with industry for the start-up (interim) period. Personnel for this enterprise should principally be drawn from industry, with a view toward the next recommended step; namely, mandate this corporation to go public no later than the interim period, and sooner if the Executive (President, Administrator of NASA, President of the corporation) or Congress determine the feasibility of such a public offering sooner than that. The transformation of the government corporation into a publicly owned corporation could also occur automatically by statute whenever the corporation reaches a "break-even" point in terms of total cost recovery for providing its services.

The proposed ideas and considerations by Comsat Corporation deserve very careful attention in this context.¹

The following are the key criteria that lead me to recommend a combination of the respective strengths of the two proposed initiatives:

ABILITY TO DEVELOP AN AGGREGATE MARKET

The market for Earth Data and Information Services is diffuse, widespread, ill-defined, uncertain and in many areas yet totally undeveloped. The challenge to put Earth Data and Information Services to direct and most effective use is a tremendous challenge in view of this wide ranging, undefined market. I know of no single government enterprise that ever has, or ever will, accomplish such an ill-defined, diffuse function effectively. This is no criticism of government nor a blind advocacy of private enterprise. It simply is an observation of fact in areas of advance technology and innovation, where again and again innovative concepts in a market context have best been pursued and brought about by private and corporate initiative. Most other nations including the Soviet Union and China, choose the corporate approach in pursuit of economic matters and matters of innovation and implementation. The United States, in the early history of its space program, also, after considerable debate and discussion, chose the corporate approach in the form of COMSAT Corporation to bring about space communications. In the case of Earth Data and Information Services a corporate approach with corporate decision processes outside the requirements, rules, operations and uses of government agencies, and, for that matter, the U.S. Congress, seems required to bring about expeditions by the aggregation of this market, and to assure its full development.

ACCOUNTABILITY

Whichever institutional form is chosen for Earth Data and Information Services, a foremost criterion has to be an accountability for funds collected and funds expended. The visibility of the funds committed and invested, as well as the return that these activities are able to obtain from industry, public agencies, private and foreign users, is very important to determine in some form the success or failure of Earth Data and Information Services during operations.

Such accountability again seems to be much better assured in a government corporate or private corporate approach than within the budgetary intricacies of any government agency.

¹ Comments of Communications Satellite Corporation (Comsat) and Comsat General Corporation (Comsat General) in response to NASA Notice 79-19, Federal Register, Feb. 16, 1979.

Certainly, the urge and the pressure to generate and develop additional markets in order to recover funds necessary for operations and further development of Earth Data and Information Services is totally different in a self-contained (i.e., corporate) approach than in an open-loop government agency approach.

INFORMATION IN MARKETS: THE PUBLIC GOOD ASPECT OF INFORMATION

The major strengths of S. 663, and the major weakness of S. 875, at this time are the financing/funding requirements of Earth Data and Information Services on one side, and the need, desire, as well as the public requirement to disseminate such information as widely as possible for its most effective beneficial public use.

In this context also a clear distinction between the benefits/value of information on one side and the ability or the requirement to generate revenues from information in markets is important: The value of information as to, for example, worldwide crop developments is indeed of tremendous value to markets, farmers, consumers and many intermediaries. Yet, once that single table of worldwide, accurate crop estimates each month is arrived at, say at the expenditure of many millions of dollars, it only takes 10 cents to reproduce that table of statistics. Two issues are raised thereby:

(1) The impossibility to "capture" through revenues some of the value of the information generated, since it is very difficult to exclude people who did not pay for the full cost of the information from the use of that information; no statute by this government or any other government can prevent the dissemination and reproduction of intrinsically very valuable information such as crop statistics.

(2) It is not in the public interest to have such information closely held by few, be it the government or be it a few private institutions; this is explicitly recognized in the United States by allocating very substantial agricultural information functions to the U.S. Department of Agriculture.

Similar, less clear examples of the difference between the value of information on one side, and the ability or desirability to have revenues generated from such values can be given in many other areas of Earth Data and Information Services. This does not mean that sizable, significant revenues cannot be generated by such data and services provided to a variety of user groups. However, particularly in the initial phases, the desirability to recover total cost nor the ability to do so with the preservation of the public good aspect of information (meaning the widest possible dissemination of such information to users) seem to be easily reconcilable. I firmly believe that after an initial period such recovery of funds can be assured. Alternatively, during this interim period it may be determined that the public interest as well as the structure of the data and information provided require continued expenditure of public funds in direct support of such services.

This concern does not exclude the corporate approach in carrying out these information and data services. However, fair mechanisms as to the contributions to the total unrecovered costs of such operations have to be arrived at both for domestic purposes as well as worldwide purposes. Hence, the call for a government corporation at least in the initial, start-up phase of the EDIS.

Reproduction for sale or distribution of data and basic information products. Both bills, S. 663 and S. 875, have special provisions for the prohibition of the reproduction, dissemination, sale or other distribution of data, basic information, or information of EDIS. Any provision of this type should be omitted from either bill or a joint bill on the following grounds.

(1) Existing statutes governing information, data, and the dissemination of data in the public and private sectors abound, and try to deal with this specific issue. To the extent that those statutes suffice for the information and data services provided by this new enterprise. Hence, there is no need for any special provision in addition to already existing statutes and laws. Either the information can be copyrighted and safeguarded, by statute or by active provisions instituted by the enterprise, or the information and data service provided does not merit any additional "special" treatment above and beyond existing protection in this area.

(2) Any special provision on top of existing laws and statutes in the area of Earth Data and Information Services will be extremely difficult to enforce, if not totally unenforceable. The viability of the enterprise EDIS, should not rest on any fictitious monopoly granted to it for Earth Data and Information Services, but rather should be based on the excellent performance of the service in competition with any other possible source for such data and information.

(3) The provision being a U.S. statute, it would only be applicable in the United States, thereby generating potentially undue discrimination against U.S.-based activities as against foreign-based activities.

(4) Proving that a piece of information has come from one source as against another source in itself seems to be close to impossible, particularly with the

increasing availability of similar information from other sources (for example, other nations).

(5) This provision so much runs counter to the general feeling that information, particularly if held by the government in the civilian area, should be available in the broadest possible, widest context.

Hence, the emphasis should be on active securing of information by the enterprise, rather than reliance on statutes that may be unenforceable and unworkable in practice.

While for recovery of cost and fees it is necessary to "market" the information, hence retain proprietary use of such information, one nevertheless should not create here a new vehicle for monopoly in addition to existing, and I think adequate, provisions of statutes governing information and data.

Further elaboration on institutional choice for earth data and information systems: The "Comsat-Intelsat" option. A mixed government-private corporate approach along the analogy of Comsat-Intelsat for communications seems to be an appropriate institutional compromise position between the ideas put forward in S. 663 and S. 875. During the initial phase (five to seven years) EDIS will be provided by government corporation under the aegis of NASA, which corporation at a suitable point (when "breakeven" is achieved) would then be sold to the public and hence achieve the purposes of S. 875.

For purposes of exposition the expression "Obsat" will be used for the equivalent "Comsat" corporation for domestic EDIS services and the expression "Globesat" corporation will be used for the analogous "Intelsat" precedent for international cooperation in the EDIS area.

In the report prepared for the Office of Science and Technology Policy entitled "Earth Information from Space by Remote Sensing"² the strong, and in my opinion correct, conclusion is drawn that international EDIS activities should be performed through an "Intelsat" type arrangement, say, Globesat. The arguments advanced in support of such an arrangement for international EDIS put forth in that report a strong, unambiguous, and particularly in view of the needs and requirements of less developed countries, the most pragmatic and best way of ensuring a rapid development of such service markets in international users.

MARKET AGGREGATION

Earth Data and Information Services occur in an extremely diffuse market, extending over hundreds, if not thousands, of different applications and user groups. These include land use applications by the Federal, State, and local governments, private companies and individuals; they include water management information services, again stretching over a variety of government, industrial and private consumer concerns; they include agriculture information to farmers, cooperatives, commodity companies, and Federal and State agencies. In forestry and rangelands a similar diversity of users and service needs can be listed. In geology Federal, private and industrial interests are again diverse, overlapping with other users in some cases, and totally different in other cases. If ever there was a diffused, disaggregated, and totally undefined market, Earth Data and Information Services clearly is a prime example of such a market.

It is a fact that no Federal agency has ever been successful in implementing and operating the benefits of new technology programs in markets, even where the markets are well defined. In other—non-market areas—there exist only two exceptions, the Department of Defense and the Department of Agriculture. In the case of the Department of Defense the research agency is also the final user, hence a definition of needs to match the research and technology development requirements to the market are "self contained." In the second case, the USDA, the establishment over many decades of the Agricultural Extension Service—comprising 20,000 to 30,000 "in field" people—is the only good example, of distributing the results of research and technology development in the area of agriculture. All other efforts by federal agencies to enter market services in technology fields, or for that matter most others, can only be called wasteful exercises of public enterprise. This is even the case where clear functions and markets are defined, for example in the case of mail services. The idea to develop EDIS in a diffuse, undefined market through a Federal institution must raise serious questions and concerns, given already a 15 year history of federal efforts in this area with as yet no operational (i.e., use oriented) commitment.

² Augenstein, Bruno, Willis H. Shapley, and Eugene B. Skolnikopf, "Earth Information from Space by Remote Sensing," report prepared for the Office of Science and Technology Policy, Executive Office of the President, June 2, 1978.

The aggregation of diffuse markets, typically has best been done by private institutions and companies, relying on private initiative and risk taking. Day to day decisions have to be made, new service markets developed ad hoc, other service markets closed down where revenues and services do not develop. An aggressive marketing policy is part and parcel of development of new service markets. Advertising, marketing, aggressive service developments may be, and are, the key to a successful new service potential that may exist in EDIS. By giving this role to any federal agency, however capable, this market may well be destroyed, and certainly delayed.

The aggregation of the market is not simply a domestic but also a worldwide opportunity and problem. The development of that market through Globesat requires such extensive and diffuse interactions with so many user groups and institutions, corporations and individuals, that certainly NASA would spend an inordinate amount of time simply coordinating such activities with other Federal agencies who have responsibility for international interaction, cooperation and treaties. (State Department, Department of Commerce, the Treasury, the Department of Defense). A corporate institution is free to pursue these opportunities aggressively, with the best national interests in mind.

ACCOUNTABILITY

Whichever institutional form is chosen for an operational EDIS (including Landsat, Seasat, aircraft, other earth observation systems) a foremost criterion for such an institution has to be accountability; visibility of the funds committed and invested, and the return that these activities are able to obtain from industry, public agencies, private and foreign users.

ACCOUNTABILITY FOR FUNDS EXPENDED

A key drawback of assigning to any federal agency a lead role, in matters of EDIS, or expanding NASA's role into operational systems responsibility, is the great difficulty to truly track and account for the funds that would go into such operations, vs. the "overhead" support activities of that same agency (NASA), and subsidizations under the title "research, development, demonstration" of new and more advanced technology. Invariably—despite any claims to the contrary—EDIS funding would be subject to overall NASA budgetary considerations.

For reasons of cost accountability, if non other, the concept of a federal agency should be opposed—in favor of a corporate approach (Obsat-Globesat) in developing and bringing about space communications.

The only notable exception as to following that precedent, is to retain the R. & D. role of NASA and the Department of Defense in EDIS, something that was not done in the communications field where now, rightly, NASA is reentering the R. & D. role.

Figure 1 conceptualizes roughly the interactions of "Obsat" (domestic) and "Globesat" the international arm of Obsat:

(1) The research and development role would be retained by the Federal Government (NASA, DOD).

(2) "Obsat" would be responsible for the space segment and ground segment down to the "pre-processed data tapes". It would be a government—and later—private corporation, with substantial Federal and industry participation, possibly by simply adjoining the Obsat corporation to Comsat, or by creating a new organization called "Obsat Corporation".

(3) The third phase in this process—the analysis, interpretation, and user services—could occur in a complete "free market" environment where user services companies, Federal user groups, State and local user groups, Globesat, as well as individual foreign, private and public user groups could interact the Obsat. Obsat may be excluded by statute from entering vertically the analysis and interpretation field, or may be allowed to complete in a separate subsidiary with all the other open market participants in that field.

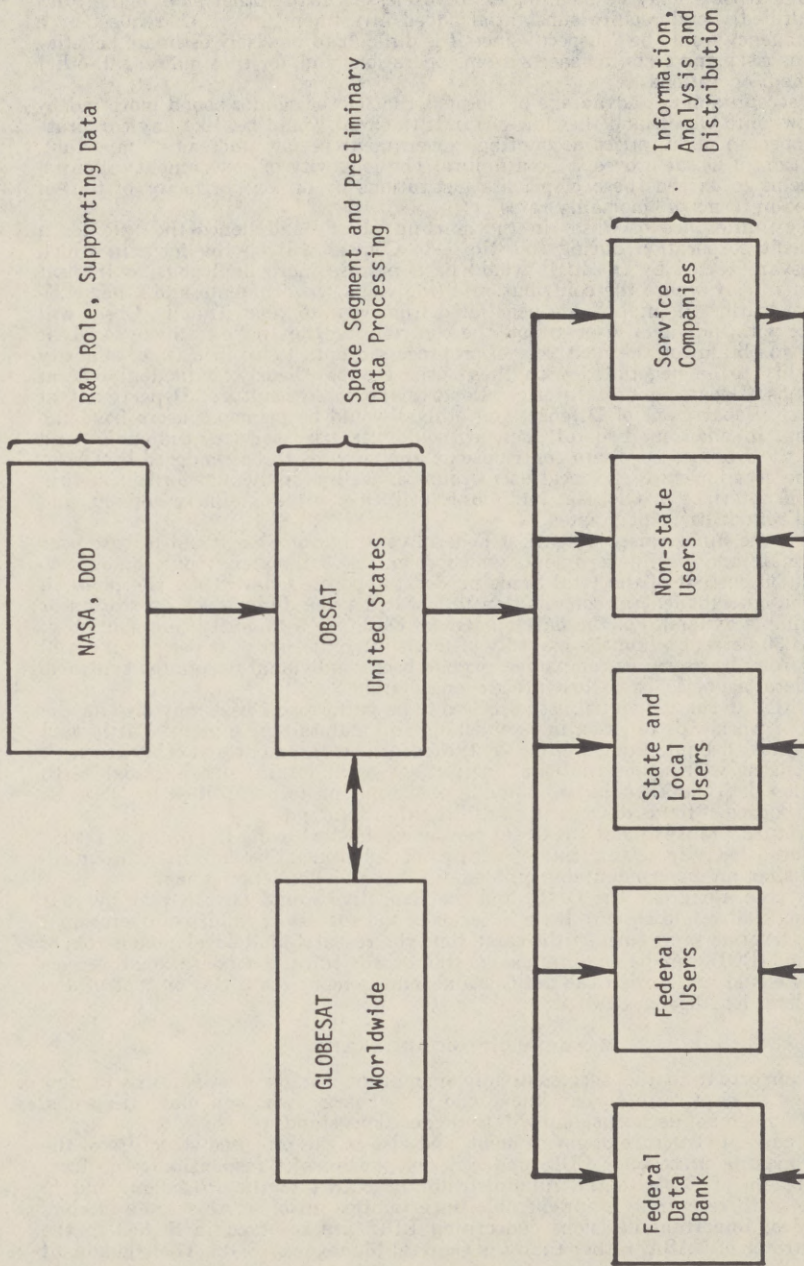


Figure 1. Data and Information Flow for Earth Data and Information Services through OBSAT-GLOBESAT Institution

ACCOUNTABILITY AS TO ABILITY TO RAISE FUNDS

As to the raising of funds, any Federal lead agency can, through appropriate negotiations in the budgetary process, always exert pressure on OMB, the Congress, other Executive branches, to continue an institution and operation that, for all practical purposes, may be meaningless or useless.³ On the other side, if the functions fulfilled would require substantial added investment, any such request by a Federal agency would be "suspect" since it is difficult to precisely estimate benefits, as well as risks and costs in space systems operations and, for that matter, all other government operations.

The "accountability" advantage of Obsat is that Obsat cannot spend more money than flows into Obsat, and the flow of funds to Obsat would be, like any corporate entity, open to audit, strict accounting, government review and, most important, termination, if Obsat proves to be a failure. The longevity of government organizations seems to exceed those of private institutions by at least a factor of ten—if measured in terms of "mortality rates".

The key difference of Obsat in the start-up phase—and hence the role for a government corporation during this time—to Comsat will be the form in which revenues are raised by Obsat: It would be a process more analogous to Intelsat operations today where the contribution of individual governments and other entities participating in Intelsat are negotiated from year to year. That is, Obsat will negotiate with individual user groups the contribution they have to make to Obsat in order to obtain for the next year(s) preprocessed data tapes in a time, quantity and quality to be negotiated with these user groups. Clearly, individual federal institutions (Department of Interior, Department of Agriculture, Department of Commerce, Department of Defense, and others) would be principal users from the beginning. In addition, Federal agencies could use user services companies and through their offices negotiate contributions and services to be rendered by Obsat. The same goes for state and local user groups as well as individual foreign institutions. The interface of Globesat and Obsat will have to be similarly defined, and financial contributions negotiated.

Initially the funds raised outside of Federal contributions, i.e., from private user groups, State and local governments, and foreign institutions, may only amount to say 25 to 30 percent of the total funds needed to operate Obsat. Over the phase-in period the outright federal contribution to Obsat may be diminished, by statute or by the simple dynamics of the development of Obsat, to a minority contribution of say 25 to 30 percent while the majority of funds after the ten year period may well come in from user services companies, private users, individual negotiated contracts with Federal agencies, as well as foreign contributions.

In addition to the individual user services to be performed Obsat may also have a national or worldwide function in establishing and maintaining a global Earth Data and Information Bank. Contributions by the Federal government and other research institutions as well as international institutions to maintain such a global earth observation data bank would be one additional function to be fulfilled by Obsat as well as a source of funds to Obsat for fulfilling that function.

The "return to investment" of Obsat can be established using fair rates of return criteria used today in setting rate structures of public utilities, and in communications. It is not an unsurmountable problem—although a challenging one.

In any case, Congress, the OMB, and the Executive would have a year by year accounting that would obscure little in terms of the success or failure of operational earth observation programs. At the same time the research and development role of NASA and DOD can be maintained, or increased, since the operational service functions would not burden the outlook and management of NASA, or that of any other federal lead agency.

MANAGEMENT ACCOUNTABILITY

Quite important in the successful implementation of any new venture in new technology services is to clearly know who is in charge, who can make decisions, who will implement decisions, and will these decisions stand.

In the current structure of government, and also in the proposed structure of the decision making process for EDIS under S. 663 the lines of responsibility go from the managers of EDIS to the Administrator of NASA to the President, and to Congress, with essentially unpredictable uncertainties all along this route of command. Most important decisions concerning EDIS are reserved in S. 663 to the Administrator of NASA, rather than the General Manager of EDIS. Their judgment

³ Kaufman, Herbert, "Are Government Organizations Immortal", Brookings Institute, Washington, D.C., 1976.

may differ, and in turn whichever decisions and requests are carried forward by the Administrator may not be sustained at the Presidential level, the Department of State of other organs of the Executive of government, and finally may be severely interfered with by Congress.

Indeed, one great difficulty today—which is only partially alleviated by S. 663—is to find out who is the decision maker on EDIS related private initiatives in government? Many officials can interfere adversely, but no one official can see a proposed private venture through the success on behalf of government. Indeed, who is government? Whom does a private venture in space matters talk to, to obtain a valid decision?

A government/private corporate approach would vastly increase the definition of clear and single lines of responsibility—a matter that cannot be achieved—I submit—within the current structure of the U.S. Federal Government. This is not meant as a critique—but as a statement of fact.

THE PUBLIC GOOD ASPECTS OF INFORMATION

The need—or public interest—exists to have knowledge and information spread as widely as possible, in order that individual user groups, decision makers, and the general public can make efficient, timely and “informed” decisions. This widespread “diffusion of information” need calls for very low, if any, user charges. On the other side, the operations of earth observation systems clearly require substantial funding to cover the fixed as well as variable cost of operations and service deliveries. A totally private operation, that is with no Federal or government involvement, even on the space segment and ground receiving end, would be close to unfeasible, due to the impossibility to safeguard information, or data, once they had been put into a form where they are easily duplicated. This contradiction between the value of information—in total—to an economy and its many users on one side, and the ability to duplicate such information and distribute it to users, whether or not they have paid for obtaining that information, has raised difficult problems in other areas pertaining to information and its distribution (publishing rights, copyrights, patents, etc.).

In this case, with the creation of a semi-public, (semi-private) institution such as OBSAT in effect the government would create a monopoly, accountable to the public through the Federal government and through “fair rates of return” criteria; at the same time the government assures beyond the “preprocessed data tapes” open and full competition, where indeed specific user needs, analyses, interpretation requirements, can be met and are met by a free market, open entry approach. The incremental cost at that stage can be borne and should be borne by individual user groups if they require such interpretive data services.

At the same time, the total system cost can be recovered through the Obsat organization by having that organization negotiate with user groups individually, and before-hand, their fair contribution to Obsat operations on a year or multi-year basis. Hence, with this scheme total cost recovery and return on investment on such expenditures year by year and over a decade can be achieved without recurring to a new federal institution, or lead agency, where issues of cross-subsidization, accountability, and market aggregation simply will prove to be unmanageable.

To summarize, the Obsat corporation, due to the monopoly granted to it for domestic uses as well as interaction with international users can assure through cost contribution negotiations the recovery of the funds needed for the space segment and ground segment up to preprocessed data tapes. Beyond this stage the free market approach to providing services to a variety of users seems to be assured, given the multiplicity of service companies that are developing in this field. At the same time, this approach also assures that through the service companies the information is made available to the widest possible market, with the possibility of different approaches to different service requirements. For example, in the area of crop information, it may well be that the Department of Agriculture—after acquiring the data from Obsat, and having interpreted these data for crop interpretation needs—will continue to publish crop data free, to everybody, through SRS and FAS bulletins.

The contract cost incurred to obtain such information shall and will be negotiated between the Department of Agriculture or the designated service companies with Obsat. In other areas, such as geologic interpretation services for specific companies, these will pay for obtaining the Obsat data under the same rules and conditions as those granted to any other resource company.

The public good aspect of improved information as well as the role of public information markets can be guaranteed and achieved, without compromising on the principle on accountability and the need of quick and comprehensive market aggregation (criteria 1 and 2).

Obsat is limited to the use of Earth Data and Information systems of the Landsat, Seasat, and related types. Clearly excluded from Obsat would be, at least for some time to come, other observation systems such as those operated by Elint.

Next comes the question of "resolution." Initially Obsat may be restricted to data and interpretation capabilities in the Landsat area, of say, down to ten meter resolution, and corresponding criteria also for Seasat data services. Information down to that level should be clearly within the charter of Obsat to develop markets for, not only on a domestic but also a worldwide basis—say through Globesat.

Some other nations might object to the free distribution of such information to everybody who wants to obtain such information, but in this case basic principles of U.S. society should be lived up to in international matters, even if that were to the dislike of some. It just happens to be that our system is based on broad-as-possible, non-discriminatory availability of information to all. It seems that down to a resolution level of ten meters indeed most other nations would agree to that principle anyhow.

As to resolution levels below ten meters I find it difficult to see how any such information can truly harm anybody else, with the assumption that through other strategic observation systems much higher resolution levels are available to the key strategic powers anyhow. This issue is not central to delegating the role to a semi-private institution like Obsat down to ten meter resolution levels to begin with; the issue of higher resolution for civilian purposes can be relegated for later decision.

As to whether "public information" is harmful to U.S. interests in some specific cases for example crop Obsat, abundant evidence has been developed, particularly on this topic, that public worldwide crop information is the benefit of the United States, as well as other nations. I believe this to be the case even for the Soviet Union, where that nation through monopoly of crop information on its own territory has in the past interfered adversely in international commodity markets to the disadvantage of others. The improved information capability to the Soviet Union through such systems vastly outweighs any benefit the Soviet Union may have gathered in international commodity markets through its current information monopoly on its own crops. (In many instances the central government there does not know much more than we do about what's going on in the fields, and suffers from a similar information gap until very late in the crop year (say October/November)).

In summary Obsat-Globesat seems an attractive workable approach to providing Earth observation services in an accountable and efficient way which safeguarding at the same time the public and the U.S. interests.

If the Globesat (Intelsat) arrangement for international provision of EDIS activities is a clearly preferred approach for a strong U.S. position, by what line of reasoning would one exclude the COMSAT analogy for domestic purposes, say, Obsat? Strong, legal, economic, or technical issues are to be at hand in order to reverse on the domestic side an institutional arrangement that has proven so successful in the area of space communications and an institutional arrangement which on the international side is found to have such strong merit also for EDIS.

The key reason for a different institutional choice for domestic provisions of such services probably include (1) financing, pricing, and cost recovery issues at least in the early stages of the enterprise and (2) national security issues. I believe both of these concerns can be adequately, and in fact better, met by an Obsat choice for domestic provisions of EDIS in the form of a government corporation initially and private corporation if feasible later on. In addition, two crucially important issues I think prove decisive for a corporate institutional choice: aggregation and development of the market, and accountability. These arguments are set forth in more detail below.

[The following information was subsequently received for the record:]

QUESTIONS OF THE COMMITTEE AND THE ANSWERS THERETO

Question 1. Can an operational remote sensing system become self-sufficient without direct government support? If not, what form should government support take?

Answer. Yes, definitely! With the following qualifications: Over an initial period of 5 to 7 years direct government support is needed. This direct government support should take the form of decreasing contributions to the annual operations budget of the EDIS entity (corporation), say from an initial 70 percent to 30 percent after five or seven years. The 30 percent direct contribution (or any other appropriate number to be determined based on then-year costs) may be continued indefinitely, for the maintenance of an EDIS archive and R&D data bank for future generations. Such a

data bank does not now exist, and is warranted on its own merits. The funding would have to come directly from the federal government (NASA?), since this is a new function not now residing with any federal agency. A continued direct contribution, however, will not be needed by EDIS after the initial period, if managed aggressively (i.e., in a corporate form).

Many federal agencies will make extensive use of EDIS, and will have to pay for such services as any other user would. But this latter form of revenue should not be mistaken—or misclassified—as direct federal contribution. It is revenue received by EDIS, for services provided.

Question 2. Would the public users (state, local, and regional governments as well as federal agencies) be able to afford remote sensing products from a private sector operation?

Answer. Yes, if the value of the information justifies the expenditure. If not, then neither should these users obtain services from a private EDIS, nor should they obtain it from a "federal" EDIS. The implication of the question—that EDIS can be provided cheaper through some federal agency activity is seriously misleading on two counts:

(1) A federal agency could "subsidize" federal, state and local users: subsidies of this form can be given equally well through a corporate private EDIS, with the advantage of making these subsidies clearly visible, year by year. In the initial period indeed such direct contributions may be called for. The same subsidy is needed for a federal EDIS, except that such subsidization would be "submerged"—and hence remain unaccounted for—in the rest of the EDIS and agency budget—in my opinion a severe drawback.

(2) A federal EDIS would "cost" less: many arguments arise why costs of a federal EDIS would—indeed—be much larger—and less accounted for—when related to services delivered to users; the only argument made for cost "savings" of a federal agency is the absence of a requirement to make a profit on invested costs. This is severely misleading: funds invested into any project, federal or private, impose the opportunity cost of capital (i.e., interest). The fact that federal agencies are laggard in calculating and attributing this cost to federal projects, can hardly be construed into an argument in favor of federal institutions—and hence a federal EDIS. It is this line of fallacious economic reasoning that is underlying many of our current problems of substantive economic issues.

Question 3. Should pricing policy be used to stimulate public usage of remote sensing data and the basic information products?

Answer. Yes. The difference between full cost recovery prices and incremental cost pricing of EDIS services, particular in the initial (development) phase, is very large. Full cost recovery pricing in the development period of EDIS will (1) certainly mean a serious delay to the full market development of EDIS, (2) can mean the exclusion of many from some of the most valuable EDIS services—such as crop information—and (3) could exclude some EDIS services from ever being developed—namely where the value of the information exceeds the low incremental costs, but is less than the much higher average costs. Direct federal support for EDIS services—whether government or private (corporate) are called for due to this need of a differentiated pricing policy in the initial service period.

Question 4. How can we insure that the needs of the public users will be met in a situation where private firms, such as the energy companies, can offer higher compensation for the data products they desire?

Answer. It is my understanding that EDIS would only provide services down to preprocessed data tapes. As long as the public has equal—non-discrimination—access to that information the public good in the widest sense is assured. If the information derived therefrom is of more value to some than to others, this will always be the case. It is not the function of the federal government to equalize values; only to assure equal non-discriminatory access to the services provided by—or under the aegis of—the federal government.

If the question is meant to imply that some will process information in greater detail to their own benefit—and at their own cost, again this is as it should be.

If the question implies that some may not be able to afford the added interpretation services, then this by itself is a good reason to exclude such users from demanding those services: the expected value they can attribute to that information (and demonstrate to venture groups) must be clearly less than the cost of added interpretation.

The only context in which the question raises serious issues is where a monopoly of information were created by a group in commodities such as crop information to the exclusion of everybody else: the gains derived from such monopoly of information indeed could far exceed its public value, and would be at the expense of other consumers. However, EDIS provides quite adequately against such misuse by (1)

giving all users equal non-discriminatory—and hopefully timely access—and (2) by continuing to make available—say crop information—through well established procedures such as the Foreign Agriculture Service of USDA. The only challenge I can see is that indeed USDA be required to make most expeditious and adequate use of EDIS for such purposes of the benefit of the public.

Question 5. Should there be competition in offering remote sensing data?

Answer. Yes for any services after preprocessed data products. As to the first part—down to preprocessed data—a single entity is called for. However, in no case should the establishment of other (private) entities be ruled out—if such groups are successful in funding their own ventures in EDIS related areas. Finally, any monopoly granted to EDIS would—in the long run be harmful to U.S. interests by unduly incentivizing foreign competition.

Question 6. Should the authority to operate a remote sensing satellite system be given to a single private entity, such as proposed by Comsat? If so, how should the Government select that single private entity?

Answer. Yes. With the qualifications and conditions as outlined above and below. As to the second part of the question this could be achieved:

(1) by, efficiently, agreeing to Comsat's proposal and charter Comsat to do so. Many arguments, including economic efficiency, experience, reasonable past history by Comsat in representing effectively U.S. interests in space application matters.

(2) by competing EDIS Corporation to industry (two, possibly three consortia might form) and select a winner based on (a) ability to develop and expand EDIS markets domestically and internationally, (b) minimum direct federal contributions asked for the interim period (c) assurance of quality of services promised (d) previous experience of consortia members in technical, information and international matters.

(3) create ex-novo an EDIS Corporation and ask for industry participation bids, somewhat along the lines of creating Comsat.

Question 7. If the Government would select a single private entity to develop, operate, and manage an operational remote sensing satellite system, should others be forbidden from conducting such operations or should competition be allowed?

Answer. Competition should be allowed—even if the government elected a federal agency to provide EDIS. Any other course would plant the roots of inefficiency, to the detriment of long-term U.S. interests.

Question 8. In your judgement, would it be possible for a private corporation to accumulate the capital needed to develop, and initially operate an operational remote sensing satellite system without Government assistance?

Answer. Yes, but the services provided by such an EDIS Corporation would be substantially different, reduced, and exclude some of the most important public information services such as public crop forecasts. Hence, in the initial period direct federal contributions to such a corporation are called for to allow (1) development of all services (2) assure public information in areas of the public good such as crop information, archival data banks, (3) enable EDIS to pursue from the beginning incremental cost pricing policies where these are called for.

Question 9. There seems to be general agreement that an operational remote sensing system will have to be regulated to some degree by the Federal Government. Where should the regulatory authority reside in the Federal Government? What aspects of the system should be regulated?

Answer. I have difficulties to find any rational, valid reasons for such "general agreement." I can pinpoint not one single case where the public good would be harmed by the absence of any such regulation of EDIS services, that cannot be achieved with the enabling legislation, namely (1) non-discriminatory access to EDIS by all users, (2) authority for incremental cost pricing policy for EDIS services in the initial period—with pursuant direct federal contributions to EDIS, (3) allowance of competition for any EDIS service where such competition can be funded privately.

If regulation indeed is required it may include (1) issues of national security and (2) service pricing policies. In case regulatory procedures are instituted for EDIS, they should reside in a new body, e.g., under the aegis of the NSC, DOD, NASA—or the Department of Commerce—specifically created for this purpose, and with explicit, strict limitations on its authority, size and staff. The FCC might be a choice of last resort, because of its regulatory experience with space communications. However, the issues in EDIS are quite different than in communications regulations.

Question 10. As you know, S. 663 gives regulatory authority to the President and the administrator of NASA and says almost nothing about what aspects of the operating organization or operations system should be regulated, whereas S. 875 gives the regulatory authority to the FCC and goes into considerable detail as to

what aspects of the remote sensing satellite service should be regulated. What are your views with respect to these differing approaches?

Answer. See Question 9.

Question 11. On what time schedule should the operating organization and the operational remote sensing be established? Do you agree that seven years is ample time for the service to establish an operational remote sensing satellite system, as provided for in S. 663?

Answer. An EDIS Corporation should be created now. The initial period to full operations may take from 5 to 7 years—and could last as long as 10 years.

Question 12. As you know, an earlier remote sensing bill, S. 3589, of the 95th Congress, authorized to be appropriated \$20 million for first year operation of the service.

Answer. Yes, and \$20 million is not enough for the full costs of EDIS services. \$100 million is more likely, when space, ground and data processing requirements are all included.

Question 13. Do you think it is possible for the institution to be self-sustaining, that is, for the income of the operating institution, either in the private sector or in the Government, to meet its expenses by the end of seven years?

Answer. Yes.

Senator SCHMITT. Our next panel will consist of Jon Davidson, Dr. Ronald Cormick, William Trollinger, and William Storie.

STATEMENTS OF JON DAVIDSON, EXPLORATION MANAGER, FOREIGN PROJECTS, SUPERIOR OIL, HOUSTON, TEX.; DR. RONALD CORMICK, MANAGER, EXPLORATION RESEARCH, CONOCO, PONCA CITY, OKLA.; WILLIAM TROLLINGER, PETROLEUM INFORMATION CORP./TGA, DENVER, COLO.; AND WILLIAM T. STORIE, JR., MANAGER, TECHNOLOGY, SUNMARK EXPLORATION CO., DALLAS, TEX.

Senator SCHMITT. Each of you, in order, beginning with Mr. Davidson, if you wish to summarize your statement, the entire testimony will be included in the record.

If you gentlemen would permit me, I have an emergency call I will have to make. It will take 5 minutes. If you would like, go with your testimony, I will be right back, and will continue with the questions.

Please go ahead, Mr. Davidson. I apologize for having to leave, but we have somebody in an office that won't leave until I get there.

Mr. DAVIDSON. Mr. Chairman, I appreciate the opportunity to talk to the committee today. I particularly appreciate this opportunity, because for a majority of my 20-year career, one of my primary responsibilities has been the integration of remotely sensed data into natural resources exploration. I apologize for not having a written testimony; however, company commitments during the past 2 weeks did not afford time for its preparation.

With your permission I will submit the text within the next 10 days.

We as explorationists are very excited about the future of remote sensing from space. Landsats 1, 2, 3, although not designed primarily for geologic purposes, have been most useful. We had made preliminary studies prior to the launch of Landsat 1 to determine how we might use the data. After receiving some of the early imagery, we found our expectations had been low. The imagery has been found to be much more useful than we anticipated.

I would like to stress with respect to the future uses of satellite remotely-sensed data for natural Earth resource exploration, that Landsat was not designed with geology in mind. The bands are not

optimized for geologic purposes. They are optimized for agricultural purposes.

In many areas vegetation, while of prime importance to agriculture, is little use to the geologist. Surface exploration would be easier if areas weren't vegetated, since we deal primarily with surface rocks and soils. We are very hopeful that in the future, satellite bands that are more useful to explorationist, will be included. Proposals for Landsat-D included some of these bands. In my opinion, the addition of these spectral bands— 1.6μ and 2.2μ —will greatly increase the use of remote-sensing data by natural resource explorations.

A second deficiency in the Landsat system is the lack of stereo, which is a very key factor in photo interpretation for geologic purposes. The question of future market potential is frequently asked. In my opinion, remote sensing is in its infancy and is used by a surprisingly small number of natural resource explorationists in industry.

Most companies have research projects that deal with remote sensing, but statistically a small percentage of the actual explorationists performing exploration today are using remote-sensing data. There are several reasons for this. The primary one is the nonoptimum data available to us at this time.

In my opinion, the major demand for remote-sensing data is in the future. We have not even begun to see the peak. The major private sector demand for remote sensing data will come from the natural resource exploration community as it has in the past. In thinking about the reasons for a private sector organization, several things come to mind. Corporations with a profit motive are much more responsive to the user's needs. If they don't satisfy the user's needs, they don't sell their products. This is not necessarily true of Government agencies, since they have other charters.

Another reason for a private sector organization is to provide continuity of data in times of political changes. Different policies in Washington or on a worldwide basis can dictate the allocation or reallocation of funds to areas outside of a program such as NASA and can cause data availability disruptions. If a company is set up to handle a certain type of data and those data are discontinued, it's of great concern and expense to the company.

Along this line, in anticipation of using Landsat-A data, Superior spent approximately half a million dollars in developing software systems and acquiring data processing hardware.

Any disruption in the data stream or changing of format temporarily stops our ability to use the data, and can cause significant additional expenditure, in order to continue using the data.

Again, private sector involvement would be more responsive to these kinds of problems, in my opinion. As I think you are aware, Geosat was formed out of frustration of individual exploration groups and individuals in an attempt to try to communicate with Government agencies on problems like these.

It's very difficult for an individual to come to Washington and get the necessary appointments or even know who to talk to about some of these problems.

We have used Geosat as a vehicle to communicate to the Government, and I think it has been an effective one that was useful from both the Government side and private sector side.

Concerning the Earth Resources Information Corp., I feel very strongly that the corporation should have great freedom in pricing and product output, and great flexibility to respond to market conditions. I realize that certain Government controls are required. However, I think great care should be taken in what controls are placed on the corporation.

Natural resource companies like Superior are experts in data analysis and not hardware development. Our past history with exploration techniques indicates that more dollars are spent on data analysis than are spent on data acquisition.

As an example, we acquired a digital Landsat tape for approximately \$200 and will spend from \$2,000 to \$5,000 on computer processing prior to any interpretation. I think this demonstrates that the present pricing policy can be significantly increased without appreciably decreasing the use of Landsat and when systems are available that are more oriented toward the geologic area, this will be even more true.

Thank you very much.

Senator SCHMITT. Thank you.

I apologize. I will catch up on your testimony here shortly.

Dr. CORMICK. Mr. Chairman, I appreciate the opportunity to appear before you in the Government process, both as a representative of the nonrenewable natural resources industry, and as a representative of the Geosat Committee, which as already mentioned, is focusing on issues of significance we think to the Nation.

Let me begin by saying that it was my privilege, if you will, to work with Dr. Fred Henderson on his previous testimony in April and May and also on the space policy bills that had hearings earlier in the year. Thus, what was already submitted into the record would be in unison with my feelings on those issues. I am prepared to resubmit copies of Dr. Henderson's testimony if you feel that would facilitate reference with respect to this particular hearing.

Senator SCHMITT. Well, we have that testimony before the subcommittee.

Dr. CORMICK. So that would be adequate?

Senator SCHMITT. Yes. We already made good use of that. It was excellent testimony.

Dr. CORMICK. OK. I would like to concentrate on a few issues in addition to those that I think still require some further clarification and emphasis. Those particular issues are before us, I think not only with respect to the two bills, but also through questions that are posed to us from other segments of Government and others who have testified before the committee. I am referring to what some may call semantics but I believe it is very important, and that is the meaning of the terms that are used and their influence on the direction of the bills.

We both refer to private sector and to private industry. We refer to users. We refer to service companies or service industry. The private sector, I don't think we have any problem with. We seem to agree it is those external to Government. Private industry is the

industrial portion of the private sector. The confusion seems to be with the users and service industry.

If I may, I would like to use a correlative in terms of the homebuilding industry, which may be something more familiar to all of us, that we can sink our teeth into. When you think of those who make the hammers and the saws and nails, and in fact those that have the hardware stores and even those building suppliers who provide the prefab units that go into making houses, those are the service companies. They are the suppliers. Indeed, they would correlate with those who make satellites, those who provide the service of the processed data and even all the way down to the prefab-type products, the computer-enhanced photos, which have even more meaning for the final user.

The user in the homebuilding correlative is the carpenter who builds the house. He has no interest in manufacturing a hammer, and that is certainly not his profit motive. Similarly, the user in our business is the explorer, the finder, the producer, the one who actually uses those products that are supplied by the service industry. There is an important distinction there.

In both bills there is a tendency to reference private industry and to think of both user and supplier in the same terms. We often come down to the question: "Why don't the users put up the money, put the money where their mouth is?" Our profit motive as users is clearly related to finding natural resources and not to making profit from data services or flying satellites.

I want to emphasize the distinction that we do, however, see the importance of that particular effort. But it is not the way in which we, as users, can evaluate rate of return, discounted cash flow or whatever. That is, when we users get together and discuss the use of satellites, the accessibility of data, we are referring to it as an incremental improvement in our guess as to a better place to drill.

We are often asked—Conoco especially because it was in public focus—why we are willing to spend millions of dollars on the privilege to drill offshore and not willing to spend millions to put up a satellite when we are busily telling Government and everybody else we believe it is useful and important. The distinction is between a drill hole, which gives us an answer and a satellite, which gives us an improved quality guess. We seek any information we can as explorers to improve the quality of our guess prior to the expensive drilling of a hole; but, as an incremental improvement on the guess we can't define for our management a rate of return on an incremental improvement. We can define for them the potential of a resource which we are going to drill and, therefore, what the rate of return might be.

We think therefore there is substantial opportunity for service industry to evolve and to be profitable. I am convinced personally that as it presently exists, there is unfortunately very little opportunity for that service industry to evolve or even to be visible so you can even get comfortable with the fact that it exists.

Let me explain. NASA from our vantage point, has a clear mandate to perform an R. & D. function. They stress R. They don't stress D; the D being development or the implementation of existing technologies, of which Stereosat we believe is an example—it is clear we do need R. & D., as has already been testified today, for

major advances in technology. We would not want them to cease any of that kind of activity. In the interests of their rather fixed pot of funds, they defer from observing or recognizing the user needs directly. If they do, it will dilute and somewhat contaminate their objectives of R. & D. If NASA, as is envisioned in Mr. Stevenson's bill, becomes the overseeing agency, were to become responsible for that particular function of operational systems, it is my considered opinion that it would be a very difficult transition for them to be both R. & D. and operational.

In the very technological exploration process in companies, it is even for us a difficult transition and yet we know it to be a vital transition of technology. In your bill, Senator Schmitt, there is a better opportunity for a separation of a corporation and yet a coordination through NASA.

I think the distinction could still be improved. I think it should be improved. I think more of the responsibilities and authorities should be placed in the hands of the corporation and less in the hands of the Administrator, being NASA.

One of the aspects I wanted to concentrate my testimony on was that separation of service, user, and Government. If you have questions along that line, I can come back to them. One other aspect that I would like to cover is on the second and third page of my submitted testimony. As users, how do we use remotely sensed data? There is a tendency to just clarify the exploration uses when we as explorers come before you at times like these. For routine and straightforward applications, there is common utilization of remotely sensed data, space accessed data. It is common, as I have listed, to use photos for land-use planning, engineering and design of coal mines, environmental plans, pipeline layouts, well-site engineering, monitoring and, of course, the logistics of exploration.

For example, where to find a way through the sand dunes of upper Egypt to move in a drill rig and thus be able to drill; or, where in Chad, to find our way through the inundated areas of flooding to the drill site; or where to lay out our next traverse, as explorers. These are not geologic uses, and yet they are important logistical uses of aerial photos.

Such uses don't require sophisticated photo enhancements. They require timely access to the data. We believe this can best be accomplished by the private sector, the service industry. That is a severe failing right now, the lack of timely access. Many times we have requests from throughout the corporation which would be rather straightforward responses if we were afforded timely access to recent data. In the absence of that, the requests go unanswered.

Conoco also has more sophisticated capabilities in the use of remotely sensed data and these facilities and experts are centrally located. It is within that realm that we make good use of the computer enhancements. Again, the applications are more than just exploration. Certainly we have located prime uranium targets, we have laid out pipeline routes through mountains, we have extrapolated geologic models for upgrading offshore drilling locations, we have pinpointed hot spots in our refineries where there may be problems and environmental issues, we have worked on ancient burnout zones in coal fields and predicted areas of intensely fractured rocks for safety control in coal mining.

We establish base maps for subsequent exploration phases, such as seismic work; and, of course, the preliminary reconnaissance phase of oil, gas, and minerals exploration utilizes satellite images. The sophistication and magnitude of utilization of such remotely sensed data are limited primarily because of the timely access, as Jon Davidson has already testified, and because of the inavailability of true Earth-science-oriented data. Thus, it is my opinion, if this kind of operational system were to move more into the private sector it would be more sensitive to the users. The service companies would then respond with facilities, with satellites, with systems on satellites which would provide the data that we need on a timely basis.

When I look at the opportunities and consider adequate institutional safeguards, profit opportunities, realizing the obvious benefits of such technology toward helping solve our shortfalls in energy and other natural resources, it seems to me a financially excellent opportunity for a Comsat-like organization. Similarly, it seems to me in this time of energy crisis politically a winner for Congress to move now on issues of satellite technology for earth science. Thank you .

[The statement follows.]

STATEMENT OF DR. RONALD K. CORMICK, MANAGER OF EXPLORATION RESEARCH,
CONOCO, INC.

Mr. Chairman, I appreciate this opportunity to testify before this Subcommittee as a representative of the non-renewable natural resources industry and the Geosat Committee. My comments on issues related to S. 663 and S. 875 will be brief so that we may have more time to discuss any additional items you wish.

Let me begin by saying that it was my privilege as a Director on The Geosat Committee's Board to assist Dr. Frederick B. Henderson, III, in preparation of his testimony given during previous hearings in April and May, 1979. That is, my voice is one of unison on the issues he raised and recommendations he made. I will, thus, confine my comments to issues which I believe need further clarification and/or emphasis. If it would facilitate reference, I am prepared to submit copies of Dr. Henderson's previous testimony.

By now you have heard testimony from service industry companies, from small independent exploration companies, mining companies, and a few large, energy companies. From the tone of S. 663 and, to a more limited extent, S. 875, plus many questions posed to me from all segments of government I remain concerned that the definitions of "private sector," "private industry," "user" and "service industry" are still somewhat fuzzy. They are of paramount significance to the success of enacted legislation so I will attempt to clarify the terms as we see them.

"Private sector" means all of us outside government, and seems to be similarly used by everyone.

"Private industry" seems to be somewhat interchangeable with "Private Sector" except that it specifically identifies industry instead of "all of us tax-payers."

"User industry" is a term often used by explorationists yet seldom recognized by government.

"Service industry" is also a term often used by the natural resources industry yet seldom recognized by government.

The problem, as we see it, is the clarification of "user industry" and "service industry" as two equally vital yet vastly different, segments of "private industry" as referred to in the pending legislation, many NASA documents, and other government reports.

To compare with a common industry, the home-building industry, the service industry would be the manufacturers of hammers, saws, nails and the like, the hardware store and even the pre-fab suppliers. The user industry would be the carpenters who build the houses and aren't interested in making hammers, let alone selling them for a living. In our non-renewable natural resources industries, the service industry is the manufacturer of seismic equipment, of special surveying equipment, of satellites; the supplier of the raw data, satellite images or whatever; even the suppliers of the "prefab"-type products such as computer-enhanced stereo

satellite photos. Service companies are vital suppliers of products for the users, they certainly help the nation's economy, but they don't build houses, and they don't explore—and that's not their profit motive!

The user industry in our business world are the explorers, the finders, the producers, the very foundation of raw materials and energy supplies that this nation has built itself upon, better than any other nation in history. As a representative from the user industry, I can assure you that: (1) we're not interested in *making* and *supplying* the satellites and seismic vehicles, but (2) we're sure interested in using them and making clear to the service industry just what it is that we need.

As I see it, the issues of difference between S. 663 and S. 875 are: (1) who will be the service industry for us, the users? government (as it is now in the earth satellite business) or private industry?; (2) if the service industry of operational earth satellite systems were permitted to move into the private sector, how and by whom should it be regulated?; and (3) how quickly can an operational earth satellite program evolve into the private sector with equitable access by all segments of the national and international community? As users we certainly have opinions on how it could operate to best serve our needs and thus, the nation's needs, but we don't have a *direct*, vested interest in the mechanics. However, it is the profit center for a potentially large and healthy service industry.

Why don't we, the users, spend millions of dollars to put up a satellite, when we spend such amounts for the privilege to drill a hole in the Baltimore Canyon? Because, the hole we drill gives us an answer. Up to the point, all we had was a guess as to the energy resource and its economic potential. An educated guess whose answer comes only from drilling. Satellites provide useful, potentially even critical, information to the geologist/explorer but they don't give answers; they only improve the quality of our guess. So, to be successful, to be competitive, all explorers will use whatever information improves the quality of our guess. But it's incremental; it doesn't give us an answer; we can't define its use in terms of rate-of-return, discounted cash-flow, etc. Our stock-holders expect us to find the natural resources and that's how we'll pay income on their investment. They don't expect us as the "user" companies to invest in satellites for income potential. That's the role of the "service industry."

What's the demand for remotely-sensed earth resources data and services? By Conoco's? By all potential users? Perhaps, the best way to respond to such a complicated question in a short period of time will be by describing how we use such data, giving the approximate historical increases in our usage, and comparing ourselves to other users.

Conoco uses remotely-sensed data and services throughout its whole organization. For the routine, straightforward applications, employees with little specialized training in photogrammetry use remotely-sensed data in the form of photos for land-use planning, engineering design of coal mines, environmental plans, pipeline layouts, well-site engineering and monitoring, and exploration logistics. The larger programs commonly involve contracting a service company to provide the photo survey. When useful products can be obtained on a timely basis from government sources, such as the Eros Data Center, they are preferred to having to fly our own survey. We find that resolution, color and stereo needs often are clearly within the limits of available or proposed satellite data products. That is, general usage of satellite data is potentially wide-spread if available on a timely and cost-effective basis. We believe this would be best accomplished by the private sector, service industry.

Conoco also has more-sophisticated capabilities and uses of remotely-sensed data. These facilities and experts are centrally located for the corporation in my area of responsibility. We have used our special computer enhancements and interpreted satellite data for locating prime uranium targets, laying out pipeline routes through mountains, extrapolating geologic models to upgrade offshore drilling locations, pinpointing hot spots of concern in our refineries, mapping ancient burnout zones in coal fields, predicting areas of intensely fractured rocks for safety control in coal mining, establishing the base map control for subsequent exploration phases such as seismic field work and, of course, preliminary oil and gas exploration.

As Conoco's remote-sensing capabilities and expertise have increased in sophistication and magnitude, so have the applications. However, two of the prime limitations to further growth of usage in our industry are: (1) the timely availability of data, and (2) the paucity of earth science-oriented data. It is my considered opinion that the level of expertise and sophistication will grow in both user and industries if legislation were immediately enacted to commit initial government support in establishing a commercial Earth Resources Information Service, utilizing satellites and other technologies, and for other purposes. Such a corporation should be responsible

for acquisition of remotely-sensed achieving and providing only raw data on CCT'S. Then, a whole service industry would evolve to provide the processed data and information services in the competitive marketplace. Let's be less concerned with regulating the fledgling corporation and be more concerned with giving it enough freedom to succeed and respond to the user's needs. Given adequate safeguards and profit opportunities, realizing the obvious benefits of such technology towards helping solve our nation's natural resources and energy shortfall; and seeing the market demand which surely exists, it seems financially an excellent business opportunity for service companies like COMSAT-General and politically a winner for Congress to enact legislation that would establish such private sector developments.

Senator SCHMITT. Thank you very much. Dr. Trollinger.

Mr. TROLLINGER. I appreciate the opportunity to testify before this subcommittee on matters I consider to be of utmost importance to the United States and the world as a whole. The testimony I present comes from a background of 22 years' experience as an exploration geologist.

The company I founded 17 years ago has been making photogeologic maps for petroleum and mineral exploration and has produced more than 3 million square miles of these maps on six continents. This has been accomplished using conventional aerial photography and, in recent years, supplemented by space imagery.

Senator SCHMITT. I presume that means 3 million square miles of coverage.

Mr. TROLLINGER. Of coverage.

Much has been accomplished by NASA since the inception of the space program, but unless there is a commitment by the U.S. Government to move beyond an experimental system, as I see it, we will lose two things: first, the technological advantages that we now have in remote-sensing satellite technology; and, two, the opportunity to make a major contribution in dealing with the worldwide energy and mineral resources problems.

Both of the bills under consideration would lead to the establishment of an operational Earth resources satellite system to augment and carry forward the work NASA has done to date. Both bills address in different ways the limitations of the present system. I won't reiterate those, because they have been discussed earlier.

I would, with your permission, like to focus on Stereosat, having participated in the Stereosat debate over the past 2 years. I find it frustrating that Government chooses to delay the development of such a useful system, particularly in light of the growing global resources problem.

Because Stereosat strikes at the heart of the R. & D. versus operational argument, perhaps it is fitting that here is where the institutional issues will have to be resolved. It's in this context that I will direct the rest of my testimony.

In my written testimony, I discuss the value of stereoscopic data and refer back to the history of remote sensing from aircraft and talk about photogeology and how it developed from a beginning of stereo viewing of aerial photographs during World War II. Originally, explorationists scoffed at the idea of being able to extract sound geologic information from several thousand feet above the surface, but when the techniques became refined, they began to realize the value of the overhead three-dimensional perspective for geologic observations. Photogeology is now an accepted and fundamental tool for petroleum and mineral exploration. It's the advance, the reconnaissance analysis.

The advent of the space program has enlarged that perspective even more and holds great promise for revolutionizing exploration techniques. I have been saying that for 17 years. I'm getting tired of saying it.

Senator SCHMITT. Don't stop.

Mr. TROLLINGER. Yet Landsat does not provide for stereo viewing. An analogy I have made—we built a car and forgot the carburetor. Photogeologic mapping is fairly routine with stereo viewing.

In my text, I point out that the user technology is in place. Hundreds, if not thousands, of geologists are presently using stereo data, principally on aerial photographs, because Landsat doesn't provide for it, except in the sidalap mode.

The science of photogeology is rendered impotent because of this deficiency. The science of photogrammetry is limited to the x and y coordinates, and the vertical dimension is missing. Topographic mapping of any quality is impossible.

Stereosat is needed to eliminate these deficiencies and unlock the vast amount of untapped information in the present Landsat scenes and those to come.

I point out several factors regarding exploration for nonrenewable resources. I don't think I will iterate those here, except to say that exploration methods are virtually indirect methods. There is no direct evidence that you have commercial oil deposits until you drill a hole.

The beginning place is the surface geologic map, which contains fundamentally three types of information: rock type, structure, and geomorphic evidence. Using state-of-the-art interpretation techniques, a trained photogeologist can produce a comprehensive geologic map if good stereo data is available, in rock-outcrop areas and even vegetated areas.

The science of geomorphology permits the reading through the vegetation to extract geologic data of surface and near-surface information. With Stereosat it would be possible to do this; without stereo, as on Landsat, it's virtually impossible to produce even a rudimentary geologic map. That is not to say you can't get information, but the information is not what it ought to be.

A surface geologic map produced by photogeologic techniques provides for the evidence of reconstructing the geologic events and for producing cross-sections showing the projections of the surface features into the subsurface where the hoped-for buried oil deposits lie. These maps and interpretations provide the broad-scale baseline of information to guide the more expensive phases of exploration, including airborne and ground geologic and geophysical surveys and ultimately, the final test, drilling.

Most of the world has not been mapped adequately geologically. This is particularly true in light of the new geology, plate tectonics. A viable operational satellite remote-sensing system will permit updating of the geologic maps of the world in the near term.

In my prepared testimony, I discussed three questions related to Stereosat. I will focus on the third.

The first question asks, "Is Stereosat not truly an operational satellite, which lies outside NASA's R. & D. charter?" One part of the answer I want to mention and reiterate, is that user technology

is "state-of-the-art." No new technology would need to be developed for Stereosat to be utilized fully.

Moreover, there is strong evidence to indicate that when Stereosat is merged with previous Landsat data, the latter imagery will increase in value severalfold.

My second question I will not discuss, because it has been addressed several times today.

The third question is the one I would like to ask and answer from the context of the service company geologist whose job it is to translate, to take satellite data, and produce information out of it that exploration companies can use to explore for oil or gas or minerals.

The question is—and I have been asked this a number of times—Will Stereosat not in fact benefit only a few users, specifically, the international oil and mining companies? This question is probably the most important here, because it's the one that has been misunderstood the most.

Stereosat will provide important data to a multitude of users outside the nonrenewable resources exploration community. There are many users waiting to get into the arena, particularly in the fields of engineering, environmental monitoring, urban planning, topographic mapping, earthquake prediction, disaster assessment, and the like.

It will also provide the scientific community a priceless tool for studying large-scale geologic processes and gaining a better understanding of the Earth as a planet. In brief, it will bring a large number of practical scientists into the arena of remote sensing from space.

Will the international oil and mining companies benefit from Stereosat? Yes, along with thousands of independent exploration companies whose business it is to explore for and produce these nonrenewable resources. It will also benefit many service companies and hundreds or thousands of individual scientists who will have the task of translating the raw data into meaningful geologic information.

However, by far the greatest beneficiaries of Stereosat, and the hoped-for operational system, will be the countries and peoples of the world. Their critical dependence on the world's dwindling supplies of nonrenewable resources is reaching crisis proportions.

The industrialized nations will benefit because new supplies of raw materials will be found to sustain their economies. The emerging nations will benefit because most of these remaining resources will be found within their borders. This represents a hope for their people for a better life.

The United States, through its private corporations, is the world's leader in exploration and production technology for energy and mineral resources. This country is also the leader in satellite remote-sensing technology. As a result of growing international competition for energy and minerals, these leadership roles are being seriously challenged.

For these reasons, I applaud the efforts of this subcommittee toward the establishment of an operational Earth resources satellite system. I urge, Senator Schmitt and Senator Stevenson, that you combine your two bills and present one for this session.

[The statement follows:]

STATEMENT OF WILLIAM V. TROLLINGER, CONSULTANT TO PETROLEUM INFORMATION CORP., AND TROLLINGER GEOLOGICAL ASSOCIATES, INC.

Mr. Chairman, I appreciate the opportunity to testify before this Subcommittee on the issues related to S. 663 and S. 875. I am convinced that the matters under consideration here are of the utmost importance to the United States and to the other countries of the world, both the industrialized nations and the emerging countries, alike. The urgency attached to the implementation of the proposed legislation cannot be overstated.

The testimony I present comes from a background of 22 years experience as an exploration geologist. The service company I founded has been engaged in photogeologic mapping for petroleum and mineral exploration for 17 years, and has produced more than 3 million square miles of geologic maps all over the world. This has been accomplished using conventional aircraft photography and, in recent years, has been supplemented by imagery from space. I am convinced, and have been convinced for many years—ever since I studied the first Hasselblad photos from a Gemini spacecraft of the western U.S.—that remote sensing from space could revolutionize our exploration methods for the earth's non-renewable resources. Much has been accomplished by NASA since then, but . . . unless there is a commitment by the U.S. Government to move beyond an experimental system—and soon, we will lose (1) the technological advantage we now have in remote sensing satellite technology, and (2) the opportunity to make a major contribution in dealing with the worldwide energy and mineral resources problems.

Both of the bills under consideration would lead to the establishment of an operational earth resources satellite system to augment and carry forward the R. & D. achievements of NASA to date. Both bills address, in different ways, the limitations of the present experimental systems.

Several of the limitations are:

Often the data does not reach the user in a timely and useful way.

A lack of commitment exists to continue the present system, causing users and developers of supporting technologies to shy away from making long-term investments in satellite remote sensing.

The characteristics of the present system are not designed for the ultimate user, at least in regard to non-renewable resources exploration.

As you know, the Geosat Committee was formed in 1976 to address the Landsat limitations and to provide NASA with input from the largest single industrial group of users on what factors were needed to optimize the NASA systems for geological exploration from space. I was a founding director of the Geosat Committee and now serve as Chairman of the Subcommittee on Stereosat.

Stereosat, as presently conceived, is a polar orbit free-flyer designed to provide a global data base of high resolution, stereoscopic, Landsat mergible, digital data. Stereosat arose from the first principal recommendation of the Geosat Committee—that a satellite be developed to provide global stereo data. Since that time, it has become a political "test case" for private sector involvement in the ongoing R. & D. vs operational argument in the field of satellite remote sensing.

Having participated in that debate over the past two years, I find it most frustrating that government chooses to delay the development of such a useful system, particularly in light of our growing global resources problems. However, since Stereosat strikes at the heart of the R. & D. vs operational question, perhaps it is fitting that here is where most of the institutional questions must be resolved. It is in this context that I would like to focus the remainder of my testimony.

What is the value of stereoscopic data and why do we need it? The answer to this question requires some background in the history of remote sensing from aircraft.

The science of photogeology developed as an outgrowth of military intelligence using stereo viewing of aerial photographs during World War II. Explorationists originally scoffed at the idea, but as the technique became more refined, they began to realize the value of the overhead, three dimensional perspective for geologic observations. Photogeology is now an accepted and fundamental tool for petroleum and mineral exploration. It has all but replaced standard on-the-ground plane table mapping, because it is more comprehensive and more efficient.

The advent of the space program has enlarged that perspective even more, and holds great promise for revolutionizing our techniques for global exploration for non-renewable resources. Yet, Landsat does not provide for stereo viewing.

The science of photogeologic mapping is rendered impotent because of this deficiency. The science of photogrammetry is limited to the x and y coordinates and the vertical (z) dimension is missing. Topographic mapping of any quality is impossible.

Stereosat is needed to eliminate these deficiencies and unlock the vast amount of untapped information in the present Landsat scenes, and those to come on future Landsats. To appreciate this it is necessary to understand several factors regarding exploration for non-renewable resources.

Exploration methods, particularly for oil and gas, are "indirect" in character. There are virtually no direct indicators that will attest to buried oil deposits. Rather, all present techniques provide "indirect" evidence of possible, or probable, buried deposits. Remote sensing from aircraft or orbiting satellites provides surface evidence which yield clues to subsurface geologic conditions.

Surface information is most valuable if a comprehensive geologic map can be produced. This generally includes three types of information; (1) discrimination of rock types within the scene (a breakdown of the individual rock formations is possible if some ground truth is available); (2) delineation of structural features, as well as mapping of the dip and strike of the inclined strata; and (3) geomorphic analysis of the drainage, land forms and tonal patterns. Using "state-of-the-art" interpretation techniques, a trained photogeologist can produce a comprehensive geologic map if good stereo data is available.

Without stereo, it is virtually impossible to produce even a rudimentary geologic map. Discrimination of rock type is most difficult because the three-dimensional erosional "form" or texture is missing. Detection and interpretation of structural features are minimized, with the exception of the most obvious "lineaments"—and even these are seldom useful unless one is able to attach structural significance to them. Geomorphic analysis on a two-dimensional scene is very limited; whereas it is almost routine for an accomplished photogeologist using stereo techniques to be able to separate rock types and map structure on the basis of combined drainage and land form analysis, even in a heavily vegetated region.

A surface geologic map produced by photogeologic techniques provides the evidence for reconstructing the chronology of geologic events and for producing cross sections showing projections of the surface features into the subsurface, where the hoped-for buried oil deposits lie. These maps and interpretations provide the broad scale baseline of information to guide the more expensive phases of exploration including airborne and ground geologic and geophysical surveys and, ultimately, drilling. It should be noted that until a well is drilled, there will be no "direct" evidence of economic oil deposits.

Most of the world has not been adequately mapped geologically. This is particularly true in light of the "new geology"—plate tectonics. We now know that many of the local structures which contain oil or minerals have been formed as a result of movements of large structures of regional proportions. Analysis of these features is best accomplished from the broad scale perspective of space. Thus, a viable operational satellite remote sensing system will permit updating of the geologic maps of the world in the near term. This will be the first step in localizing those areas of high potential for oil or mineral resources—for quick follow-up by the more detailed and expensive exploration phases. The starting place is Stereosat.

I would like to conclude by addressing several questions that have been raised about Stereosat. Answers to these questions are germane to the larger questions regarding the development of an operational remote sensing satellite system.

1. "Is Stereosat not truly an 'operational' satellite, which lies outside NASA's R. & D. charter?"

It is probably closer to operational status than any program in view at this time. However, some components of the current design have not yet been tested in space, and some fundamental technical questions still need to be answered. One thing is clear, however; the "user" technology is "state-of-the-art." No new technology would need to be developed for Stereosat to be utilized fully. Moreover, there is strong evidence to indicate that when Stereosat data is merged with previous Landsat data, the latter imagery will increase in value severalfold.

2. "Is the marketability of Stereosat data near at hand, and if so, should not the satellite be funded, at least in part, by the private sector?"

The Geosat Committee produced a report in November 1978 entitled, "Stereo Satellite Data Product Market Assessment." This report has been previously submitted for the record of this Subcommittee. In brief, it indicates that, given several market assumptions and governmental actions, a market for Stereosat data probably exists which would amortize the 1978 \$100,000,000 program over a 6-10 year period. This market would include private sector and government users.

Regarding private sector involvement in funding, this can probably only be achieved under an operational system such as is proposed in these two bills. Its success will be dependent upon the institutional arrangements made between the government and the private sector. Several factors seem clear:

The "private sector" in this context will likely be a "service" company, rather than a "user" company, such as an energy or natural resources company. The Geosat Committee has polled its "user" members and has learned that there is little interest in their getting into the satellite remote sensing business. They do, however, anticipate purchasing data which they, or service-to-user companies, could translate into geologic maps or other valuable information.

There will be substantial technical and market risks associated with Stereosat. The private sector company willing to accept those risks must be assured of commensurate reward potential. This will require that government agree to purchase its data from the private sector service and also agree not to compete with that service. Moreover, the pricing policies must be not only adequate to provide a fair return on investment, but must be equitable among all users, including government.

3. "Will Stereosat not in fact benefit only a few users, specifically the international oil and mining companies?"

This question probably is most important, primarily because it is in this regard that much misunderstanding exists. Stereosat will provide important data to a multitude of users outside the non-renewable resources exploration community, particularly in the fields of engineering, environmental monitoring, urban planning, topographic mapping (less than first order), earthquake prediction, disaster assessment and the like. It will also provide the scientific community a priceless tool for studying large scale geologic processes and gaining a better understanding of the earth as a planet. In brief, it will bring a large number of practical scientists into the arena of remote sensing from space.

Will the international oil and mining companies benefit from Stereosat? Yes, along with the thousands of independent exploration companies whose business it is to explore for and produce these non-renewable resources. It will also benefit the many service companies and the hundreds or thousands of individual scientists who will have the task of translating the raw data into meaningful geologic information for use by the exploration companies.

However, by far the greatest beneficiaries of Stereosat (and the hoped-for operational system) will be the countries and peoples of the world. Their critical dependence on the world's dwindling supplies of non-renewable resources is reaching crisis proportions. The industrialized nations will benefit because new supplies of raw materials will be found sooner to sustain their economies. The emerging nations will benefit because most of the remaining non-renewable resources will be found within their borders, providing a boost to their economies and a hope for their peoples for a better life.

The United States, through its private corporations, is the world's leader in exploration and production technology for energy and mineral resources. This country is also the leader in satellite remote sensing technology. As a result of growing international competition for energy and minerals, these leadership roles are being seriously challenged.

For these reasons, I applaud the efforts of this subcommittee toward the establishment of an operational earth resources satellite system to bring to fruition the R. & D. achievements made by NASA to date. In addition, at its most recent meeting in May 1979, the Space Applications Board agreed again to support these views. It is time, gentlemen, that we put the space program to work for this country and the world. It is my hope that you begin with Stereosat.

Thank you.

Senator SCHMITT. Thank you.

Mr. STORIE. Mr. Chairman, Senator Schmitt, I am pleased and appreciate the opportunity to testify before this subcommittee on behalf of Sunmark Exploration Co. and to present my views on S. 663 and S. 875.

I wish to commend Senator Stevenson and Senator Schmitt on their desire to get this very important legislation reported by the committee for the Senate's early consideration.

I have studied the introductory statements and S. 663 and S. 875 as presented by Senator Stevenson and Senator Schmitt to the Senate. I am in complete agreement with many of the statements.

The United States is the world's leader in developing remote sensing satellite technology. We should use this knowledge to build an operational remote sensing system that benefits this country and others in managing the Earth's resources. If we do not act,

other countries, such as France and Japan, will take the lead in offering these services.

This presents a problem, not only one of national interest, but one of national security. The apparent indecision of the administration on how to or whether to initiate an Earth Resources Information System requires positive action on behalf of the Congress of the United States in our own best interests.

Remote sensing technology has assisted in discovering minerals and hydrocarbons worldwide. It is no longer appropriate to consider this technology research and experimental. Our dependence on a few countries to satisfy our huge demand for oil is reason enough to go all out in our remote sensing efforts worldwide. Imagine what would happen to oil and certain critical mineral prices if some of the emerging "have not" nations of the world become exporters of oil and minerals. Data from the Landsat program has been of value, future information from Stereosat, Landsat D, et cetera can and will help solve our dependence on so few countries.

Considering the long leadtime in developing sensing systems, gaining acceptance and use as they may apply to exploration and engineering programs, and to finally realize the development of operating mines and oil and gas fields, we should realize the urgency of committing the United States to formation of a permanent Earth resources information service.

Feeling as strongly as I do concerning the value of an operational remote sensing satellite system to this country, I ask the question, How quickly can we achieve this operational system?

In my view, a commercial Earth Resources Satellite Corporation should be established and could be operational within 2 years after enactment of the act. The elements necessary to such act can be found in the two bills under consideration.

The involvement of a private entity in the operation of a remote sensing satellite system would be the best means by which to assure achievement of a successful operational system. A major problem is to aggregate the market, and no governmental agency can do that better than private enterprise. Placing responsibility for the operational system in a private entity would, in my view, meet the needs of the Government and other users for satellite remote sensing data, result in the least cost to the Government, to the taxpayer, and to other users, and bring about the maximum range of available products and services.

The development of economical and efficient services also is the best means by which to maintain the U.S. leadership position in this area, as well as its ability to meet the inevitable competition that will arise in the sale of remote sensing satellite data products and information worldwide, a market which the United States has borne the major expense of creating.

It is apparent that the satellite remote sensing technology developed by NASA and others is advancing well ahead of our industries abilities to assimilate and utilize it. This will change with time, but in the meantime, the operational mechanisms for the transfer of this technology from the governmental research and development to private sector operational utilization should begin. This can be achieved by the coalescence of S. 663 and S. 875 and passage of

legislation embodying the purposes and intent of these two bills in 1979.

Considering S. 875 bill as a base from which to start, I offer the following views:

1. Title II, section 201(b)2. I wonder if an additional approval is needed by NASA.

2. Title II, section 201(c). I am not familiar with the mission of the various agencies, so do not feel qualified to comment whether or not the FCC is the appropriate agency to regulate the activities of the Corporation. It appears that the regulatory activities cited in section 201(c) are all-encompassing.

This Corporation will have a 17-member Board of Directors who should be able to set policy and insure that many of these provisions are carried out. Specifically, I wonder why sections 201(c) 4, 5, 6, 7, and 9 need to be included under this subsection.

3. Title III, section 302. I do not understand how many incorporators the President will appoint and what segment of the population they will represent. I think NASA should be heavily involved during this organizational period.

4. Title III, section 303(a). I feel that NASA and the USGS should be considered for representation on the board.

5. Title III, section 304(b)2. While I favor a wide distribution of stock, I doubt if enough investors will buy stock in a new rather risky business. Therefore, I would be in favor of removing part (b)2 from the act or increasing the percentage.

6. Title IV, section 404. Twenty million dollars may not be enough to acquire 20 percent of the Corporation if this is the intention of this statement.

In summary, in my view, time is the critical factor. The private sector currently is in possession of the necessary technical skills to undertake establishment of an operational system. Several bills have been considered in past years; many studies have been made and reports issued and discussed.

We should postpone no longer the next step in development of an operational system that meets the needs of the private sector and governmental users.

Senator SCHMITT. Thank you, sir.

Gentlemen, I would hope that you would feel free to answer or comment on any and all of my questions.

Based on earlier discussions, would you comment on the problems that the FCC representative foresaw with S. 875 in that it would basically be a monopoly organization providing raw and possibly preprocessed data to the market.

Do you foresee any problem concerning availability of data or price of data in having that kind of monopoly with respect to your operation?

Mr. DAVIDSON. From a standpoint of raw data, I realize all these terms need definition, if I understood the gentleman from the FCC's testimony this morning, he indicated the raw data would probably be defined as what was received at the ground station.

In past systems, that data is not usable to anyone without some—

Senator SCHMITT. I wouldn't assume what he said would be the definition. I am more concerned about your interaction with the monopolistic organization.

You have all interacted with A.T. & T. and presumably other large corporations that either are or tend to act like monopolists.

Mr. DAVIDSON. We are a user of both raw data and processed data. For some purposes, we need the raw data. In fact, the data isn't raw enough in its present form.

We certainly would want access to raw data. We would not want to be prohibited from massaging that data in any manner we saw fit to accomplish our purpose.

If there is some restriction based on the service industry or the user industry as far as what is done with the data, I see that as being a great problem.

In fact, I think it would be a problem for the corporation or whatever entity is set up.

Senator SCHMITT. We would expect any value-added activity in general, still not able to define the difference between data and preprocessed data, to be competitive.

If somebody wasn't doing what you want, you go to somebody else or do it yourself. The real concern I am trying to get at is that all of you supported the development of a private corporation but if it's a monopolistic corporation, what kind of problems should we protect you from?

Mr. DAVIDSON. I guess the primary problem that comes to mind is pricing. In a monopoly, you always have to be concerned about the price side.

However, if it's priced too high for the users, they won't sell anything so I tend to think the pricing will seek the level at which the Corporation can make money and the users can pay or the law of supply and demand.

Therefore, I am not terribly concerned about it. If the tapes are priced at \$100,000 a piece, I doubt one will buy them.

At \$2 a piece, we would buy lots of them. There is an area in between where there is sensitivity and some lack of sensitivity.

Senator SCHMITT. Do you think it would help to have a user-based corporation—that is, have the users of the data also be stockholders in the Corporation?

Mr. DAVIDSON. If they chose to do so, thought there may be—as a user, as a representative of a private company, anytime we get involved in an investment in data, we want the data to be profitable because we see it as something we invested money in and want to maximize our ability to make profits from it.

That is a corporate directive. I see great conflicts in having a user community that is also owning the data and is in control of how the data flow goes.

I also suspect the user community is not terribly interested in being involved in that type of operation.

Exploration is very people-intensive. We are people short. We tend to not get into areas we can stay out of in data acquisition.

All companies have gone away from primary data acquisition and have left that to the contract area and have concerned themselves primarily with data analysis.

That is where we want to stay. We don't want to be involved in data acquisition.

Senator SCHMITT. You want to purchase data you can use and even in some cases, probably processed data depending on what the particular value is that has been added to that data.

Mr. DAVIDSON. Yes.

Dr. CORMICK. Let me try to respond if I may.

The issue of a monopoly is, of course, one not only of concern to us, but would be to the Justice Department. I guess I would respond as far as our concern—

Senator SCHMITT. The reason we have the FCC in as a regulator of monopoly is to enable us to get away from antitrust problems. It would be a concern of the Congress and the independent agency that regulated it, whoever that it is.

Dr. CORMICK. One issue is certainly pricing. I think when you referred to users, you may not have meant the users Jon responded to.

I think there is certainly a financial opportunity for the service companies such as Comsat, ITEK, GE, Hewlett-Packard and so on—not wanting to leave anyone out. Certainly there are several others who are interested in the manufacturing end of the business of satellites and other smaller entities who would evolve but can't now because EDIC provides those products which they otherwise would have provided, who would have an investment interest in the new Corporation.

I think that if you wrote the bill such that a true opportunity exists, they would invest. I think you could also write a bill that would require and not just permit that NASA consider the private-sector interests in taking over or in doing some research or putting up a satellite that is a test case. Require them to respond to such opportunities either jointly or separately.

Your bill does reference the opportunity of R. & D. within the Corporation as well as coexisting R. & D. still within NASA so it somewhat takes care of that.

The other issue that is really fundamental is: I would be terribly concerned about a monopoly that didn't have to respond to a timely and cost-effective type of world we live in.

Especially the timeliness of data. That is an issue where if they came down to the point of providing data in its preprocessed form to the competitive industry. That was not timely and made available to all at the same time, obviously the service industries would not evolve into a healthy industry and the user community would be quite hampered.

I don't foresee that as a difficulty if the proper type of requirements are placed upon the Corporation. I do, however, think that doesn't require regulation. It requires a setting of boundary conditions. Once a corporation knows what its boundary conditions are, it can operate within that and with a profit motive and an opportunity so expressed it can go ahead and be quite innovative as we heard in earlier testimony.

To have somebody regulating it as to its explicit action in one detail or another is where a fledgling corporation will die or where it could significantly be hurt.

Mr. Storie emphasized those particular items in the bill that are more toward just regulating issues rather than setting boundary conditions which say, "OK, you can run within these limits."

Senator SCHMITT. Would you include rate of return on investment as one of those boundary conditions?

Dr. CORMICK. I certainly would.

Senator SCHMITT. Something that should not be regulated.

Dr. CORMICK. You should have a rate of return opportunity and—you shouldn't regulate it within a very narrowly set limit.

In other words, it should be a significant—there is nothing dirty about the word "profit" in my mind.

If they saw an opportunity for significant profit that defined a rate of return that was 40 percent, that shouldn't be regulated out of existence by whomever.

Senator SCHMITT. You are saying that as an end user you would be the regulatory pressure on them. If they priced themselves out of your market—

Dr. CORMICK. I am convinced that is what capitalism was intended to accomplish, actually does, but has been obscured by the regulatory agencies.

That is my personal opinion. I really believe if we went back to that concept, it would be successful.

Mr. TROLLINGER. May I address that? Concerning the monopoly question, if this private corporation must aggregate the market, which is not yet defined, in the very beginning this corporation has a monopoly to lose money.

It must first develop the market. As it develops that market, I think the incentives are there if the boundaries are wide to continue to expand that market, and I see very little problem in the area of it becoming a gouger of the user.

Now, in the value-added area where competition exists, that isn't part of this question. But since they, first of all, must aggregate the users and then they must, in sensitive response to user needs, move to continue to expand the market, I think the question probably is moot, at least for a few years.

I think maybe a high end, Senator Schmitt, if the profits get obscene—that's a word we all heard a lot about—if they—how should I define that?

Senator SCHMITT. Would you like us to write a definition of obscene in the bill?

Mr. TROLLINGER. I think I shan't be the one to do that. I want something more tangible to my claim to fame.

I really feel it's moot in the beginning because it's a monopoly to lose money. They will take a risk. Let's let whoever this private sector company might be have the opportunities and if they are constrained to pay back that investment some way, and that gets into the question of how much Government subsidy, and that's another one, I think they want to expand the market.

We want them to expand the market. I don't think that they will gouge and limit that market. I think there are incentives enough that if they have to aggregate the market, that that question of them making obscene profits from this are moot at least for 7 or 8 years.

Senator SCHMITT. So 7 or 8 years from now when there is an operating corporation and this committee has an oversight hearing on that we can expect the four of you to come and say they are making too much money?

Mr. TROLLINGER. If we do, would you remind us of our testimony? I don't think that we will be doing that. I think we will be too busy.

Senator SCHMITT. It would be in your self-interest. If you are really starting to use that information in large volume and it becomes a significant part of your costs, it would be in your self-interest to come in and tell us the corporation needs to be reregulated. Right?

Mr. DAVIDSON. I think limiting rate of return will be a problem. We can see in various countries around the world where tax rates are abnormally high, the people cease to be productive. It is a problem we might have in this country. I have great problems with regulation of a company with the type of risk capital this is, to tell the parent investors not only do we ask you to put a lot of money up front in a risky venture, but we will limit your rate of return. I wouldn't put my own money in that type of venture.

Mr. STORIE. The main issue to me is that we need to do this and do it as soon as possible. In my view, really the only way that we might be able to do this in a short period of time is with the type of organization that is implied in your bill. I think that I personally would be willing to take the risk that we wouldn't be gouged by this type of corporation. I think with the need for this data and this information being available to us in a short time frame, most of us would be willing to take whatever risk we would need to take.

Further, this corporation being in my view quite a risky venture, should have the very minimum of regulations put on it. I think if they become a big monopoly, something could be done about that later. I am not really concerned about that.

Senator SCHMITT. Gentlemen, would you each comment briefly on what you think are the critical elements of the transition from where we are now to some privately based corporation. Who wants to comment first?

Mr. DAVIDSON. The most critical element I would see would be the lack of prohibitions or the lack of regulations. If a group of people are assembled in the corporation that are inventive, that see the potential to make profit and see the potential to make it work, they should be given a pretty free rein.

Senator SCHMITT. Should they be required to assume control of Government assets in this area?

Mr. DAVIDSON. At the present time, I don't know what they will be dealing with, if they don't deal with Government assets. I don't know where they would start. The data we are talking about is basically Landsat data. It is only semi-attractive to the exploration user community because it is not a geologic satellite. It is an agricultural satellite.

The area of how the company interfaces with the Government in selling data to the Government, which I presume is what would happen, is an area that will be, I suspect, a lot more of a problem than dealing with private industry. How much the Agriculture

Department pays, how much Department of the Interior pays, et cetera, for use of the data.

Dealing with private industry I don't think would be a great problem.

Senator SCHMITT. Should they be free to dispose of those resources as they see fit when other technologies or other capabilities warrant?

Mr. DAVIDSON. They have to have that freedom. If they are required to maintain everything forever, that will be a terrible liability on the company. Again, I think the board would, if properly chosen, supervise and make wise judgments.

Senator SCHMITT. What about the problem of insuring that new technologies are integrated into the service?

Mr. DAVIDSON. The user community will demand that.

Senator SCHMITT. It apparently depends on the level of capital and plant investment that has been made, doesn't it? A.T. & T. had that problem for many years. They have now tremendous plant investment. Until recent years when competition started to rear its ugly head, they did move slowly in the introduction of new technology.

Mr. TROLLINGER. Senator, on that question, I think—while I think it is necessary in the beginning to make an agreement with this private-sector company that there will be no competition, I think if down the road there is new technology that might be useful and the users are clamoring for it, if the corporation does not respond, I think then there ought to be an option that Government could have to allow another company to come in and provide that option. Then let them decide that on the level of whether that competition will be serious to them.

Senator SCHMITT. Neither bill would prohibit that, although if you require the Government to buy from the initial corporation—there are other indirect ways in which another group would be inhibited financially from getting involved. But that is one option—depending on the nature of the service—and whether another entity could capitalize competitive service.

Mr. TROLLINGER. In the very beginning, the market is so small and disaggregated it would not be at all prudent to consider having two companies compete in remote sensing. If you give one company the monopoly in the beginning, that monopoly should not be for all time if someone else wants to come and provide another service. If the other service is one that company A doesn't want to gamble on, then I think a company has to put their money where their mouth is. Maybe the Government would let them compete.

Senator SCHMITT. Say we get to the position of where a satellite lifetime is 30 years instead of 5 or 7. That is a heck of a disincentive to put up a new satellite if you have to amortize that investment over that period of time.

Mr. TROLLINGER. I agree.

Senator SCHMITT. What do we do? Which would result in obsolescence of satellites? Some people say I am not in much danger there because a 30-year satellite is unlikely but I don't think it is unlikely. A few years ago they said a 1-year satellite was unlikely and we increased that by a factor of 10 in major areas. TDRS is supposed to be a 10-year satellite, I believe.

Mr. TROLLINGER. I would support what Dr. Heiss said earlier. We can't anticipate technological advances. I don't want to get into that game. I have been surprised too often.

Senator SCHMITT. I want to be sure you have access to all the new technological services this corporation would potentially be capable of providing. I don't want to build into their infrastructure, their corporate structure, those things that would inhibit investment in new technology. All I am asking is how do I prevent that? You are all business people.

Mr. TROLLINGER. I think in the beginning, since this corporation must be given assurances that the Government will not allow another company to compete for that service, but if it comes down the line where new technology is coming and it is clearly within a reasonable risk return, then I think that company should be asked do they want to fly one like this? If not, they are going to allow company B to compete.

Senator SCHMITT. What you are saying is the basic incentive of an investor-owned corporation will still be there. The investor wants to earn a rate of return on his investment. If it takes new technologies in order to attract new users or keep users from other foreign competition, the corporation will have to move in that direction.

Mr. TROLLINGER. I am saying that and also I wouldn't let the provision of a monopoly to be all encompassing. If new technology is developed over here and they are precluded from getting that up in the air because of this noncompete clause, then I would give them an opportunity to break the noncompete clause, provided that they are willing to assume the risk and that it really is—so the compete clause would not be all inclusive for all remote sensing for all time, in my view.

I think, having that, then I think the corporation will respond properly to bringing in new technology if it is valid and it is within an operational mode.

Mr. DAVIDSON. I see two buffers in this area. One is there are other countries that are going to be flying satellites and will probably be developing new technologies in these areas which will be competition for a U.S. monopoly. It is not a world monopoly. The Japanese and French are talking about these kinds of things right now. From a natural resources standpoint, we don't need 30 years of the same kind of data on one scene. We will buy it one time and for the most part, won't be interested again. We will be interested in new technology and new data. It is the acquisition of new technology and data that will cause us to buy and rebuy and rebuy again.

Dr. CORMICK. In previous testimony. Dr. Henderson listed some of the actions required by Government to enhance the private sector involvement. There are three sorts of information services. I will mention some of those briefly, because they answer in part what you asked. Certainly Government would need to work with us to identify the Government users and establish their responsibility as far as committing to purchase data.

One of the most diffuse aspects of private sector involvement on a profit motive basis is recognizing a significant percentage of the purchasers of such data are Government and that they are on a

yearly budgetary basis, where they feel inhibited from committing toward the purchase of minimum amounts of data, or where they give absolutely no assurance that there is anything of use, or where they would not be precluded from getting the data with their own system. That certainly would be a concern, if they felt that they weren't inhibited by this particular corporation from sending up their own satellite for their own specific uses, albeit somewhat the same as what the corporation was providing—in other words, they would need to be in the fold in the same way as the private users. As the Geosat committee representatives, we deal with the different Government sectors, who are indeed users, and we find it very, very difficult to identify who they are, what their responsibilities are, what their voices are with respect to the national interest, the restraints that they feel, and so on. Some of the other points are in dealing with non-U.S. users. Certainly in establishing this particular type of corporation that would be a problem, if it hadn't been established adequately on the Hill and maybe even in the U.N. that a private corporation or the Government corporation had that privilege and an opportunity to deal directly with other governments. If the corporation didn't have that right, who was going to deal for them as the Defense Department does with purchases of defense contracts or contracts of airplanes, and so on, with other countries? There would be some coordination needed in this area or the private sector would hold back.

Comsat in their testimony listed several other points related to restraints on private sector involvement that I think we would support as actions that need to be taken by Congress and the administration before a corporation could actually go into service.

Senator SCHMITT. Mr. Davidson, you brought up a point—this will be the final question, although we will have some questions for the record—and that is the fact that initially, with the given technology—technology not only in collection, but also in processing, value-added processing, you would buy one batch of data and then wait for the next few innovations to come along.

This corporation would get an initial market that obviously would be valuable in supplying you with that first-shot data or supplying the service companies with that first-shot data. Then, for its continuing revenues, still assuming the existing technology, it would be dependent on those users that buy repetitive data, which is generally not the mineral resource industry, although I think maybe we all have underestimated the value of looking at terrain in several different seasonal aspects, so that may be broader than one would think at first blush.

Do you have any other indication of your mineral resource industries of buying repetitive data, given an existing technology base?

Mr. DAVIDSON. Now repetitive data is more of a processing problem. The reason we tend to buy single image in an area is because the software technology of massaging two different images that don't overlay in a computer is very expensive today. It exceeds the limits of many people's hardware.

I think, as we come to grips with that software problem, we will do more multiseasonal data. We have done a limited amount, but only visually. We haven't done any computer processing. Some

companies may have. I still think from a natural resource standpoint there are a limited number of sales. Whether there is one or four or whatever it is. However, the first Landsat flew in 1972 and we still have significant areas of the world where there is no coverage.

Senator SCHMITT. No useful coverage?

Mr. DAVIDSON. No coverage, period. There is just no coverage. Central Africa, some of the areas in Angola which aren't cloud covered all the time. It just isn't turned on. There are other priorities in the system. As you know, the priority was at one time to satisfy a specific user group. I understand that. These kinds of things would be attacked in the corporate mode versus the Government mode.

Senator SCHMITT. The renewable resource area, those areas where the Government tends to provide the service to the public, they would tend to be more dependent on repetitive coverage than the kind of thing you are doing. Is that a fairly general distinction to make?

Mr. DAVIDSON. Yes, I think that's correct.

Senator SCHMITT. Two heads shake and one shaking no. Mr. Storie didn't even move.

Mr. DAVIDSON. Looking at the user group, we had trouble getting statistics on the user group. If you take out all the Government-funded data use, including not only Government agencies but schools, universities, State governments, local governments, et cetera, and talk about the industry user group that is using the data in a profit motive, the best numbers we can get are about 90 percent are natural resources, exploration companies, mining and oil companies. They also represent something approaching half of the total sales from the numbers I have seen—40 to 50 percent. So about half of the use of Landsat or slightly more than half is Government agencies and about half is private sector, and the private sector is natural resource exploration.

How many times the natural-resource company will use it will vary. Some companies say absolutely only once. I heard one major oil company said they wanted 10 or 12 scenes of the same thing. That depends on the individual exploration effort and how it's used. I don't think there is one answer.

Senator SCHMITT. You had a dissenting opinion. Dr. Cormick?

Dr. CORMICK. Yes. In my initial testimony I tried to allude to the many multitude of uses that we make in our corporation of Landsat-type data, certainly, of aerial photos. We find that for many of the needs, often the resolution, stereo needs, quality and so on, those are clearly within the capabilities of existing or proposed systems. In those cases, they comprise a significant part of our corporation's purchase of the initial data.

So when you are talking about the primary corporation providing the initial data, if you look through that list you would find that the majority of those uses require repetitive data. The minority of uses don't require that. But all of them require the same kind of purchase of a scene or scenes.

It's the subsequent enhancement or sophistication of handling of the data that either the service industry or the sophisticated user themselves would do that is influenced by the final application of

that use. But as far as the purchase of the initial data, all of those other uses are very significant. They represent a large portion of activity within our corporation.

If you aggregated that activity in any total energy company from the point of starting the decision to explore to the logistics all the way through to the production problems, drill site locations, engineering, well site locations, environmental monitoring, down to the final continuous monitoring of refineries and so on every one of those aspects, we could end up using aerial photos. The increased usage of coal is just barely recognizing the more sophisticated uses of such remote-sensing technology for its industry.

It's a very conservative industry. It's very slow to move into this area.

One other point. You talk about purchase at one time, and no later purchases. Purchases are done now, but then we move into other areas of interest and return to the archiving of data and purchase again.

Purchases do extrapolate over large periods of time and they are dependent on new ideas and new areas of interest and new problem areas and so on. It is not just for repetitive coverage that would continue the purchasing of data.

It is change in needs through time. Both are real.

Mr. TROLLINGER. If I might, I will piggyback on that and be somewhere in between the two points of view. Due to the fact that exploration companies, for exploration purposes, primarily will not use a great deal of repetitive data—you may have seasonal data, so we will talk about 1 to 3 or 4 copy sets of the same type data.

Superior will take that information and use it and keep it exclusive to their use, their interpretation. Conoco will also buy that data for the same purpose. Neither will publish. And neither will the data that is waiting in the archives to be sold to Sunmark—will become redundant. It will be used—different interpretations.

So many of the companies—that is, for the exploration companies to utilize this. Now, the scientific community—

Senator SCHMITT. Wait. You are a value-added service. Would you purchase it twice? Let's say each one of these gentlemen contracted with you for your service. Would you make one map for both of them of the same area? What factors do you consider? If you are working on an area for one, you won't work on it for the other?

Mr. TROLLINGER. That is true, but probably I will make a study out of it, the data at that time, at that state of information I have got, and sell it to all of them. So I may make one use of it for a given area, but by and large, there will be service companies like mine whom I compete with every day doing the same thing.

If I restrict myself to less than the very best type of imagery, people decide not to buy my work. My company probably flies more aerial photography than any other company in the country.

It may not today, but we fly our own—we don't use Department of Agriculture photography any more. We fly high-resolution color photography. We used to make maps using photos from the USDA.

In any event, I would say, Senator, that there are many companies who will use it and there is a restriction on, certainly, the

information they derive from it. It does not become available for the public record. That is, on the exploration use.

I agree with Ron also that there are many uses of this data—I am thinking particularly of Stereosat—in studying the dynamic processes, or dynamic as far as a few years are concerned, that they will want to have new updated information. Particularly the areas that I believe will be of great interest will be the earthquake prediction, geologic mapping along faults to coordinate with the geophysical analysis of movements along faults, timely disaster assessments, environmental monitoring—all these companies have to make environmental impact statements—this kind of business will require at least reasonably timely information.

Senator SCHMITT. Your prediction is we will require the competitive coverage for a variety of reasons; because of an accumulation of stress of some kind, or an accumulation of events that lead to some kind of potentially catastrophic situation; is that right?

Mr. TROLLINGER. Yes, sir. I also feel the data bank of information that will be derived will not ever be obsolete. If it is good imagery, it will continue to have use, even though it is replaced by other images.

Senator SCHMITT. Primarily because of value-added services, learning how to apply new technology to the same data?

Mr. TROLLINGER. Exactly. Also, we are not able to extract every bit of information we go for. A company hires us to do a study for a certain purpose. There is more information in there than I have extracted in the beginning with my staff. We have a specific purpose.

We will go back and extract additional information and make a different—

Senator SCHMITT. Do you want the corporation with a subsidiary competing with you?

Mr. TROLLINGER. I don't understand the question. Say that again?

Senator SCHMITT. Do you want this Earth Resources Corp., which is providing the raw data—do you want them competing with you?

Mr. TROLLINGER. They would be welcome. It won't bother me.

Senator SCHMITT. In your area, value-added—

Mr. TROLLINGER. It won't bother me a bit.

Senator SCHMITT. What would you require? Full cost accounting between the services? If they are getting to become a high-rate return organization, they can't cross-subsidize your competitor?

Mr. TROLLINGER. I think there should be some concern in that area. If they will charge me three times what they charge their own entity, it would be difficult for me to compete. However, I won't preclude them from having a subsidiary as long as they don't lockup and get into the value-added business with a leg up on the rest.

That wouldn't be appropriate. I think a modicum of constraint there—I again believe—

Senator SCHMITT. We know enough about those problems now to avoid them.

Mr. TROLLINGER. I agree.

Senator SCHMITT. They have existed in the past, but in a new entity like this we can probably insure they don't happen in the

future. We still have problems in the communications industry for historic reasons.

Mr. Storie, do you have anything to add?

Mr. STORIE. Yes, Senator. I might say that in your introductory statements when you read this bill to the Senate, you covered very well some of the uses of this data from the satellites.

I think that there are many things that probably are unsaid in your statement that we will see in the future. We learned a bit about ourselves today. We are rather secretive about how we do our exploring.

You saw the yes-and-no responses here. I am quite envious of Superior and Conoco that they do their own data enhancement. We don't. We buy imagery for different seasons of the year. We have a small group working on this.

We hire companies like Bill Trollinger's and others to do work for us as consultants.

Mr. TROLLINGER. So does Superior and Conoco.

Senator SCHMITT. Thank you very much, gentlemen. Clearly the last comments indicate that everybody looks at their own corporate or company situation, what they are trying to get as an end product, and they handle information such as this in the best way possible.

What we have to make sure of is that the raw data at least is available so you can make those kind of decisions. If it is not available, you are not going to have that option.

Thank you very much for your testimony. I hope we can count on you to answer some questions for the record. It was very interesting. Thank you.

[The following questions were subsequently asked by Senator Stevenson to the panel witnesses to be answered for the record. Dr. Cormick informed the committee that he in general agreed with the answers provided by Mr. Davidson and that he would not be sending independent answers:]

QUESTIONS FROM THE COMMITTEE

Question 1. If the organization that develops, owns, and manages the operational remote sensing system is established in the private sector, either now, as suggested by S. 875, or later as could occur under S. 663, how should the system be capitalized?

How should the continuing operations of the system be financed?

What role would you want the federal government to play if the operational remote sensing system were made the responsibility of the private sector?

Question 2. There seems to be general agreement that an operational remote sensing system will have to be regulated by the federal government. Where should the regulatory authority reside in the federal government? What aspects of the system should be regulated?

As you know, S. 663 gives regulatory authority to the President and the Administrator of NASA and says almost nothing about what aspects of the operating organization or the operational system should be regulated, whereas S. 875 gives the regulatory authority to the FCC and goes into considerable detail as to what aspects of the remote sensing satellite service should be regulated. What is your view with respect to these differing approaches?

Question 3. On what time schedule should the operating organization and the operational remote sensing system be established? Do you agree that seven years is ample time for the service to establish an operational remote sensing satellite system, as provided for in S. 663?

Question 4. As I'm sure you know, the executive branch of the government, under the aegis of the President's science adviser, Frank Press, has set up a number of committees to study what the United States should do with respect to operational

remote sensing satellites based on Landsat technology. These reports, of which there will be three, we are told, will soon be completed and hopefully the executive branch will have their recommendations with respect to operational remote sensing satellite system ready and be a part of the fiscal year 1981 budget decisions. Further it is our understanding that the executive branch believes that before proceeding with a definition of the institutional framework for the operational system they must know what the technical characteristics of the system are. Do you agree with this? If not, why not?

The Subcommittee's approach is to first establish the framework for the institutional structure and then let the institution decide on what the operational system should be, since the system, as time passes, will clearly change. It seems most important to establish an institution that is flexible enough to deal with the changing technology. What are your views with respect to this approach?

Should the institution which develops the operational remote sensing satellite system or the government determine the technical characteristics of the operational system?

Should the legislation include any detail with respect to the design or technology of the operational system?

Do the bills, S. 663 and S. 875, cover the basic elements that ought to be covered in the legislation? Do these bills deal with the basic elements in sufficient detail? Too much detail?

What are the principal issues that should be considered in determining the kind of organization that should manage an operational remote sensing system?

What should be the role of the federal government? The state and local governments? The users in the private sector?

What services should the organization that will develop, own, and manage the operational system to provide to the users?

Should competing remote sensing satellite systems be permitted? And, if so, on what basis?

Question 5. International application of remote sensing technology is on the rise and shows great promise. Currently the United States has seven Landsat ground stations operating in foreign countries. Other countries are undertaking to establish their own satellite remote sensing systems.

The Subcommittee would welcome your thoughts on how the United States can eventually bring together these separate initiatives into an integrated and complementary effort. Some people have proposed a single global information system, managed by an international authority. Others suggest that we accept the fact that a number of national systems might function simultaneously, but in a manner that avoids needless overlapping and redundancy. What are your thoughts on how the United States should proceed internationally with respect to operational remote sensing systems? How should we move toward an orderly international arrangement?

Question 6. Both S. 663 and S. 875 have been criticized for not giving the consideration to the institutional arrangements at the government/industry interface in order to enhance the transfer of remote sensing technology. What are your views with respect to this? Should this interface be treated in the bills under consideration by the Subcommittee?

Question 7. The federal government is notoriously poor at bringing into widespread use the new technologies whose development it has sponsored. On the other hand, American industry is good at marketing goods and services.

Yet, recently it is alleged industry has been slow to undertake risk ventures involving new technologies without substantial government support. Why? What should the United States Government do to get industry to increase their risk ventures involving new technologies so that less government subsidy is necessary?

ANSWERS OF JON W. DAVIDSON

Answer 1. A workable basic model for the financing and transfer of Government space technology into the private sector has been established in the communication field some years ago. I see no reason why this approach would not work in the operational remote sensing area. The federal government through various agencies and project funding is today the largest user of remotely-sensed data from space. I would recommend that the federal government consider a guarantee purchase of products for some time period (5 years $\pm$) which should aid in obtaining funding. Some parts of the private sector user community may also provide purchase guarantees if they are dealing with a private sector organization.

Answer 2. I would suggest that regulation be approached with caution. Most of the regulating should be performed by the Board of Directors of the corporation

with guidance from the corporate charter. The remote sensing corporation will have to respond to an as yet, poorly defined user community and in some cases probably generate markets which don't exist today through education and advertising. Too much federal government regulation will impede the success of the corporation and also raise the price of the final product to the user's both government and private sector.

Answer 3. The operating organization should be placed in the private sector as soon as adequate funding would allow it to operate. If the transfer to the private sector takes seven years, the resulting company would look more like a government agency than a private sector company and I would be surprised if the transfer would ever take place.

Answer 4. Question number 4 attacks the very heart of the issue. If the federal government is going to fund and manage operational remote sensing from space then they clearly have to make the final decisions, hopefully with technical input from the private sector, on system design.

Alternately, if the private sector is going to be asked to directly fund development of an operational system, they should be given a free hand to respond to the user community and provide products that are in demand and that the user community is willing to pay for. I favor the latter approach because I believe it will be most responsive to the user community needs, both government and private sector.

The questions of technical characteristics, services, etc. should be left to the Board of Directors of the Corporation. The organizations, governmental or private sector, and individuals that provide the funding should be represented on the Board of Directors in proportion to their funding level.

Concerning the final part of Question 4, our country was founded on the principal of competition in a free market place. Competition is a healthy alternative to government controls and should be encouraged.

Answer 5. A significant part of the user community desires and has need for a worldwide remote sensing data base. If the private sector corporation approach is chosen then it should be given this international responsibility in its charter since the areas outside the U.S. represent a major market place. If responsibility for operational remote sensing is maintained in the federal government, then a worldwide data base should be maintained and made available to the U.S. user community.

Answer 6. When responsibility for operational remote sensing is transferred to the private sector the interface between the supplier and the user will be maximized because of the suppliers' desire to respond to the user community's (purchaser's) needs. The remote sensing community will not purchase significant quantities of data that do not fulfill their requirements.

Answer 7. Industry has been and is prepared to undertake risk ventures provided the opportunity to make profits proportional to the risks are present. In recent years excessive government regulation, paper work and controls have made the government a not very silent partner in most business ventures. Compliance with a myriad of government regulation is taking ever more of the corporate executive's time (and of the consumer's \$\$) with less time available to plan new business ventures.

My suggestions for improvement include a repeal of unnecessary bureaucratic red tape and regulations. New and old regulations should undergo a cost benefit analysis to determine if their value is worth the cost to the consumer since they, not the corporations, will ultimately pay the bill. Sunset provisions should also be put on all regulations to require their periodic review.

If government incentives are deemed necessary, they should be in the form of tax credits and fast right off's rather than government subsidies. Companies spend their own manpower and funds on projects they think have a significant chance of success, while people stand in line for a government subsidy regardless of its merit. A tax dollar entering the federal government is significantly reduced by the time it leaves as a government subsidy and is incumbered with a host of regulations.

ANSWERS OF WILLIAM V. TROLLINGER

Answer 1. I believe capitalization should be accomplished from the private sector entirely. It seems to me that there is questionable benefit in requiring the Federal Government to own a minority interest in the corporation. Accordingly, it would be counter-productive to limit ownership of any single stockholder to 10% or less. Indeed, the investors in this corporation will be taking significant technical and corporate risks. There may be only a few with a degree of technical sophistication and financial resources willing to venture into this area.

Continuing operations must be financed from product sales to federal, private and international users. There will likely be deficits in the early years until these markets are fully developed. In say, the first 5-7 years, the Federal Government should commit to annual purchases of a minimum dollar amount of products. This would likely be between 50-75 percent of sales needed to break even. Perhaps a formula could be developed on a graduated scale with the larger guaranteed purchases in the earlier years. This subsidy is based on products and not on hardware. The private corporation would bear all technical risks. By this subsidy it would behoove the government to help develop markets within the various governmental agencies. The private sector corporation would have the responsibility to develop all the other markets. As sales increased, the formula could provide for decrease in subsidy.

Answer 2. I have no background to provide a useful opinion on where within the Federal government the regulatory authority should reside. However, there is precedent and some logic to argue in favor of the FCC.

For the best results for all concerned, the less regulation the better. Hopefully, oversite rather than regulation would be the answer; particularly in assuring that U.S. interests were best served in regard to national security and international space policy.

Answer 3. Time is of the essence. Seven years is too long to bring the operational system into the private sector.

Answer 4. I agree wholeheartedly with the subcommittee approach. It is virtually impossible to define the technical characteristics of the system because, as you say, it will certainly change with time. I believe we do know the technical characteristics needed for the first part of the system, i.e.—Stereosat.

It is understandable that some technical characteristics of a satellite remote sensing system are of vital national interest. The most critical of these is resolution. Stereosat calls for resolution of 15m IFOV. Surely, this degree of resolution should cause no major international problems. Future systems for natural resources exploration should require no finer resolution than 5-6m IFOV, or 10-12m GRD.

The private sector organization which develops the operational remote sensing system must determine the technical characteristics of the system. These characteristics must be determined by user needs and not by arbitrary government fiat.

Factors dealing with national security or international space policy should be the only design or technical details included within the legislation.

Both bills deal with the fundamental elements, but I believe in too much detail. I would hope that an operational remote sensing satellite system could be implemented within a broad, flexible set of guidelines which would allow the private sector company to innovate without undue constraints.

The principle issue, it seems to me, to be considered is whether an operational system should be developed and operated by a government or a private company. Past experience dictates that the government is not able or oriented toward providing services to the private sector. If it is agreed that the private sector should be given this responsibility and opportunity, then all other issues and provisions should be formulated to assure early success. This way, all concerned will benefit the most.

The role of the Federal government should be threefold: 1—R&D (NASA has done a superb job here). 2—Oversite; primarily on matters related to national security and international space policy. 3—Users of the products.

State and local governments will be users of the system, just as companies within the private sector. The role of all users will be to order and purchase products, and in so doing let the operating company know what products and services are in demand. The operating company will be responsive to user demand because its chief goal will be to increase its markets. The services needed by the users will be provided, or the users will not buy.

Competing remote sensing satellite systems should not be permitted, at least in the early years. Because, the market is not now large enough or well defined enough to support even one system, much less several. It should be recognized however, that competition already exists in the form of the proposed French and Japanese systems. Monopoly abuses might occur and might take several forms. In addressing these however, extreme care should be taken lest incentives be insufficient to induce the private sector company to take the full technical and marketing risks. On pricing, I feel the private sector company should have a free hand, provided that all users pay the same, with normal discounts allowed for volume or advance purchases. On profits, I would advise against limits on rate of return until all investments were amortized. Even then, there could be better ways to address the problem. For instance, profits over an agreed percentage limit after investment is recovered could be set aside for reducing government guarantees needed on the

next generation of satellites. On technology lag, allow for competition if Company A seems to be dragging its feet.

Answer 5. No doubt there will be competitive systems. The international marketplace can best sort all of this out. The history of communications satellite technology should be beneficial here. We should hope that the U.S. systems prove to be the best and most profitable, since most of the R&D investment to date has come from this country. We must realize however, that time is of the essence.

Answer 6. No government agency is oriented toward effective technology transfer. This will be a welcome burden to the private sector company whose responsibility and incentives are aligned toward expanding the market for his services. In my view this will develop fast and automatically if the private sector owns and manages the system.

Answer 7. Part of the reason that industry is slow in this field is that remote sensing from space addresses principally *global* problems. This risk venture is international in scope, and is subject to a myriad of unknown political problems before it can be exploited. Huge investments and great risks are involved . . . with uncertain returns.

In order to encourage industry to undertake these risk ventures, the government should do all it can to help reduce the risks to assure a reasonable chance of success. In this case the government should agree not to compete and to purchase a minimum amount of data when it becomes available.

Why should the U.S. government underwrite a private effort such as this? In so doing, it can (a) maintain its leadership position in remote sensing satellite technology and (b) make a major contribution in dealing with the worldwide energy and mineral resources problems.

ANSWERS OF WILLIAM T. STORIE, JR.

Answer 1. I would think that the system could be capitalized similarly to the way that Comsat was. The continuing operations should be financed through product sales. I see the government's role to be one of continued active research and development of new technology remote sensing.

Answer 2. I feel that regulation should be held to a bare minimum. I addressed this question in my statement before this subcommittee.

Answer 3. I am in favor of transferring the earth resources information system from the Federal Government to the private sector as soon as possible. I would think this could be accomplished within a year after favorable legislation is passed and the system could be operational within two years.

Answer 4. Clearly, a decision needs to be made. If the Federal Government is not going to operate a remote sensing system, they should remove themselves from contention and allow the free enterprise system to function.

My answer to parts two and three of question four is "yes". Part Four—the legislation should not include detail with respect to design or technology of the operational system.

I think the basic elements are in the two bills, but deal with too much detail.

Answer 5. We need worldwide remote sensing data. We should maintain and improve our position internationally.

Answer 6. I do not think that it is necessary to consider interface in the bills.

Answer 7. I do not agree that industry has been slow to undertake risk ventures involving new technologies. I see the problem here to be one of tremendous delays brought on by unnecessary regulations and environmental constraints, permit delays, red tape, etc.

There must be a profit potential to undertake the risk. Excessive costs and time delays brought on by the above are the cause of the problem.

Senator SCHMITT. The hearing is adjourned.

[Whereupon, at 12:32 p.m., the hearing was adjourned.]

[The following information was subsequently received for the record:]

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
Washington, D.C., October 11, 1979.

Hon. HARRISON SCHMITT,

Ranking Minority Member, Subcommittee on Science, Technology, and Space, Committee on Commerce, Science, and Transportation, U.S. Senate, Washington, D.C.

DEAR SENATOR SCHMITT: Enclosed are NASA's responses to general questions for the record which you submitted by letter to Dr. Frosch on May 16, 1979, in connection with the hearings by the Subcommittee on April 9 regarding S. 663 and

S. 875. Please excuse the delay which necessary coordination has caused in our returning these responses to you.

Our records indicate that this completes the information requested of NASA for the Subcommittee's April 9 hearing.

Sincerely,

TERENCE T. FINN,
Director, Office of
Legislative Affairs.

Enclosure.

GENERAL COMMENTS

The Administration is committed to an operational earth resources system. The definition of this system is awaiting the completion this summer of two studies, one in the area of integrated remote sensing systems and the other on private sector involvement. We are also continuing to work with potential users in the planning and system definition for an operational earth resources system. Until these studies are completed, we believe the Federal government should not commit itself to any specific option. Therefore, the concept of implementation of an operational earth resources system through a "chosen instrument" as described in S. 875 is considered premature at this time.

Question. During the course of the hearing, you indicated that NASA would provide a detailed analysis of S. 875. In your analysis, would you be certain to address the following issues:

Section 201(a)(4) of the bill provides that the President shall, consistent with national security and the objectives of the Act, transfer to the Earth Resources Information Corporation any function and parts of functions of any other Federal entity or officer which relates primarily to functions of the Corporation. In addition, the President may provide for appropriate transfers of records and property. What functions and parts of functions of any Federal entity or officer would be appropriate to transfer to the Corporation? What records and property would be appropriate to transfer to the Corporation? What price, if any, should be attached to the transfer of records and property?

Answer. Before considering function and property transfer to the Corporation, it is necessary to have an understanding of the needs and requirements of both the R. & D. system and the operational system and the roles of the organizations which will operate these systems. Since these needs and requirements are still under study, it is premature to make judgments or estimate the costs regarding these transfers.

Question. Section 201(a)(7) of S. 875 provides that the President shall insure that each Federal entity which utilizes Earth resource data and information provided by the Earth Resources Information Corporation shall purchase such data and information from the Corporation at a just and reasonable price except where a separate Earth resources information service is required to meet unique government needs or is otherwise required in the national interest. What are your views regarding this requirement? What would be in your view unique government or national interest needs sufficient to not require purchase of Earth resources data and information by a Federal entity from the Corporation?

Answer. We agree that flexibility should be allowed to meet special national security needs as well as the need for continuing research and development activities. How these needs can be met and what requirements upon Federal entities utilizing earth resources data and information should be established are issues currently under review by the Administration.

Question. Section 201(c) grants to the Federal Communications Commission numerous regulatory authority over the Earth Resources Information Corporation. Is the FCC the appropriate Federal agency to regulate the activities of the Corporation or would another Federal agency be more appropriate?

Answer. We believe the government should first decide what regulatory aspects are required for such a system. Once the necessary regulatory aspects are agreed upon, then the question of which specific agency is best equipped to undertake this responsibility can be better answered.

Question. Should the terms "raw data and information," "preprocessed data and information," and "processed data and information" be defined? If so, how should they be defined?

Answer. Yes, these terms should be defined.

Raw data.—The immediate output of a sensing or imaging device. For space systems, it is the data as received at a ground station from the satellite.

Preprocessed data.—Physical quantities which have been derived from raw signals which have been edited and manipulated through the application of calibrations and corrections.

Processed data.—Preprocessed data which has been further processed to produce data products which are standardized or tailored to specific user requirements. These data may exist in a variety of formats such as computer compatible tapes, film products, etc.

Information.—Intelligence extracted from data products through appropriate analysis, through consideration of data from a variety of other sources, or through the use of physical models. Information extraction is normally performed by the data user or a service supplier.

Question. What benefits and difficulties would the Federal government experience in working with the Earth Resources Information Corporation as established in S. 875? How could such a corporation be structured that would minimize difficulties while maximizing benefits? What problems have been encountered by the existing LANDSAT system and how could the creation of a private operational Earth Resources Information Corporation contribute to the alleviation of such problems?

Answer. The Corporation established by S. 875 would for the first time create a single entity responsible for an operational Earth resources system. Such a Corporation is one institutional arrangement that possibly could help to aggregate the market for earth resources products and provide the motivation to develop the full potential of an operational system. It might also be advantageous in transferring the burden of the operational system costs from taxpayers to the actual users. Other aspects, such as the continued need for research and development and data requirements of the Federal agencies, are important issues which must be addressed and for which we do not foresee simple solutions. How best to address the diverse needs of government, state and local users, private entities, and academic institutions in remote sensing is an issue under discussion within the Administration. We do not believe that the technical difficulties encountered in the Landsat program could be any more readily resolved by the Corporation. The problems of sensor reliability, frequency of coverage, timeliness of data products and the complexities of processing large quantities of data have to be addressed regardless of how the system is managed.

Question. S. 875 provides for a continued NASA role in the activities of a private sector operational Earth resources monitoring system, including appropriate research and development activities. Are the functions and responsibilities assigned to NASA pursuant to the provisions of S. 875 appropriate?

Answer. What role NASA should play in an operational Earth resources monitoring system is a subject currently under review in the Administration.

Question. What principles should govern the integrated development by the civilian, defense, and intelligence sectors of space systems, including satellites, ground facilities, and data utilization? What effect has the interplay between the interests and legitimate concerns of these sectors had upon the development and implementation of an operational private sector Earth resources monitoring system?

Answer. The Nation should have a system which meets civilian, defense and intelligence needs for space remote sensing in the most efficient manner while ensuring that the data acquisition, distribution and security requirements of each area are met. These needs are presently being addressed in the Integrated Remote Sensing System Study (IRSSS), scheduled for completion shortly.

Question. Does S. 875 make adequate provision for the safeguarding of national security interests?

Answer. We are currently studying the best way to proceed to an operational Earth resources system, and it is too early to answer questions based on an assumption that a private corporation will be the best way.

Question. What are the major constraints that presently exist that discourage the private sector from developing an Earth resources information operational system? What do you envision to be the development costs associated with the development, by the private sector, of an operational Earth resources information system?

Answer. There are several issues that confront both the private sector and the government that must be overcome before private sector operation can be considered a viable approach. The principal questions are the long term risk and cost of such a system given the present limited knowledge as to the extent of a defined market and the potential for growth. Additional issues are the extent to which alternative data sources may exist and the impact of specified limitations resulting from the yet to be defined regulatory function of the government. These issues as well as the developmental costs associated with an operational system are currently being studied within the Administration.

Question. How would you envision the development of markets for Earth resources information data by the Earth Resources Information Corporation created in S. 875? Is there an adequate market to support private sector involvement in the Earth resources information field? How long do you envision that an expanded market for such data would take to develop? How much of the market demand would be from government sector?

Answer. The Interagency Task Force on Private Sector Involvement in Civil Space Remote Sensing (PSIS) is pursuing these issues to determine the extent of commercialization possible and the mechanism for involving the private sector. As indicated in testimony before the House Subcommittee on Space Science and Applications, Committee on Science and Technology, on May 3, 1979, it is the intent of the Administration that the results of this study will be made available to the Legislative Branch.

Question. S. 875 provides that no stockholder of the Earth Resources Information Corporation, other than the Federal Government, may own more than 10 percent of the shares of voting stock of the Corporation. Would you please comment on the provision?

Answer. Any comment on whether to limit ownership of a private sector Earth resources system is premature, given the full review of the subject currently being undertaken by the Administration.

Question. The time period during which an operational Earth resources information system would be transferred from the Federal government to the private sector is an issue that deserves further discussion. If that time period is too long, or if the transfer to the private sector is left uncertain, we may find that the system will never be spun-off to the private sector, resulting in continued inefficiencies in the distribution and marketing of the data and increased agency control over the data system. Would you please comment on this issue and give your views concerning the optimal time period and framework for the transfer of this function to the private sector?

Answer. The Administration is currently studying how best to establish an operational Earth resources information system. A focus of this study concerns the appropriate role for the private sector. It is premature at this time to speculate whether the Federal government would operate such a system for a period of time prior to a transfer of the system to the private sector.

Question. How long would it take the private sector to develop and make operational an Earth resources information system?

Answer. The Administration is currently studying how best to establish an operational Earth resources information system. A focus of this study concerns the appropriate role for the private sector. It is premature at this time to speculate whether the Federal government would operate such a system for a period of time prior to a transfer of the system to the private sector.

