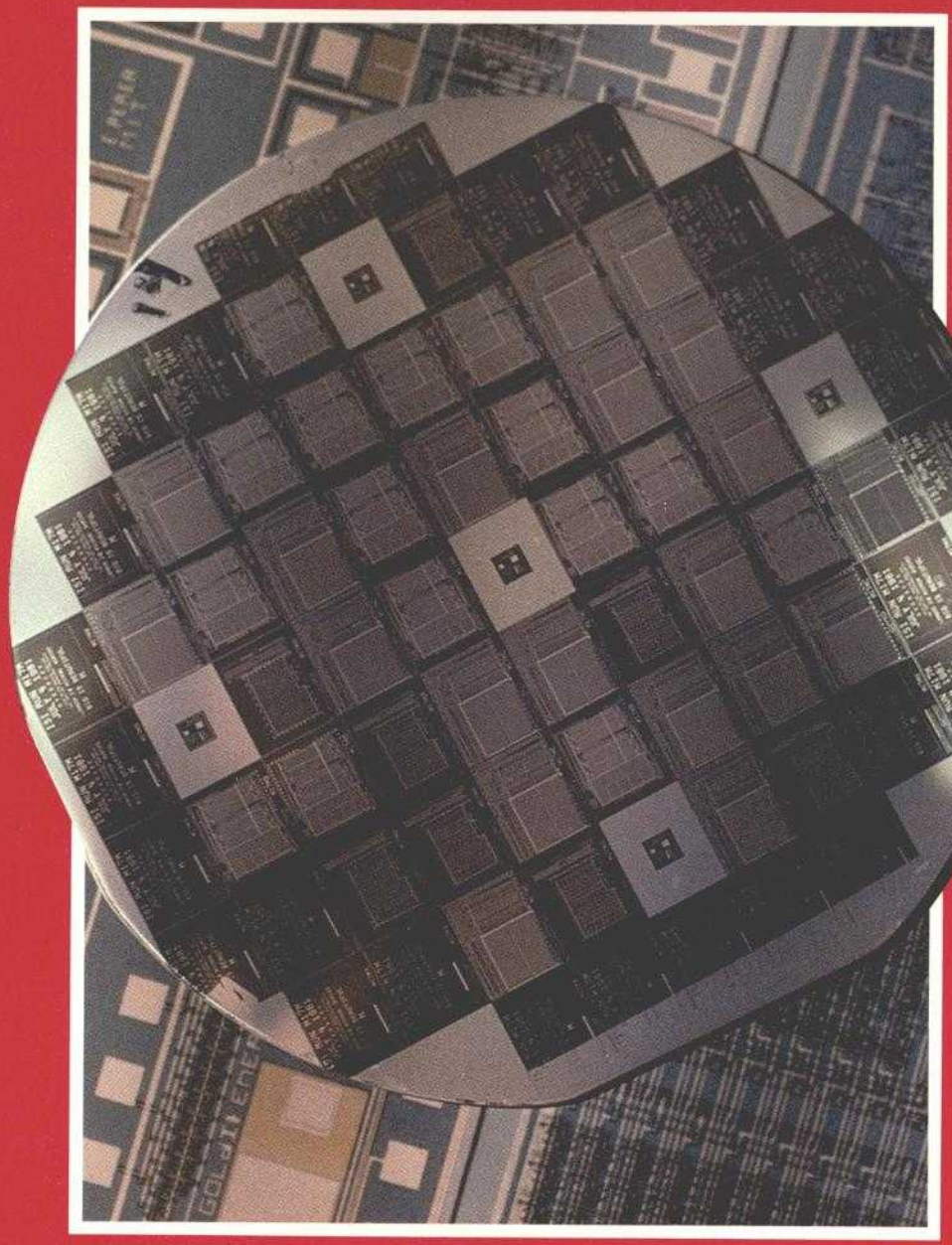
COMSAT®

COMMUNICATIONS SATELLITE CORPORATION MAGAZINE

1982



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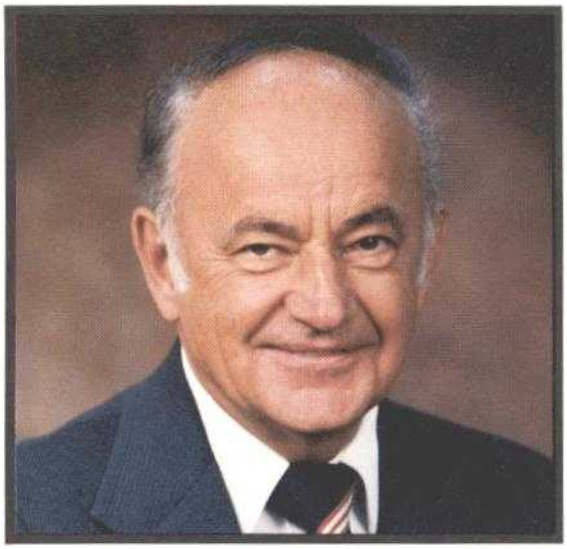

by Dr. Joseph V. Charyk
President and Chief Executive Officer
Communications Satellite Corporation

The addition of Comsat General TeleSystems and Comsat General Integrated Systems to the Comsat family through actions taken by Comsat General Corporation, our wholly owned subsidiary, are significant events in the history of the Communications Satellite Corporation. They also should be seen as a logical outgrowth of our mandate to bring the maximum benefits of satellite communications to the largest number of people.

Comsat General TeleSystems was formed to serve as a manufacturer of products for use in satellite-linked ground systems, principally the digital electronics portion of such systems. Starting with echo cancellers—devices that make long-distance voice circuits echo-free—TeleSystems also is now involved in the development and the marketing of shipboard terminals to operate with the Inmarsat maritime satellite communications system, and it is just now introducing the first in a family of Time-Division Multiple-Access (TDMA) equipment, some of which it will develop jointly with the Harris Corporation. TDMA, a digital communications approach, promises far more efficient use of satellite capacity than that possible with the conventional Frequency Division approach.

As for Comsat General Integrated Systems (CGIS), we expect this young organization to be a potent force in the exciting new computer-aided design (CAD), computer-aided manufacturing (CAM) and computer-aided testing (CAT) arena, particularly as these techniques apply to the electronics industry. CAD, CAM and CAT are already proving to be excellent vehicles for improving the productivity of industry, and CGIS, by joining CAD, CAT, CAM with communications technology including satellite communications approaches, will enhance their inherent benefits manyfold. The prospect of being able through CGIS to play a substantial role in helping efficient U.S. industries to become even more efficient and to help other U.S. companies out of their present productivity slump is a very exciting challenge to us at Comsat.

Recently, Comsat General Corporation reached agreement with Amplica, Incorporated, a major builder of solid-state microwave amplifiers based in Newbury Park, California, to purchase the outstanding shares of that organization. Amplica will, we believe, be playing an increasingly more important role as a supplier of hardware in the explosion of satellite communications applications that is taking place in the decade of the 1980s. Indeed, we believe that all three organizations—TeleSystems, CGIS and Amplica—will strengthen Comsat's leadership in satellite communications technology in the years ahead.

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Cover: The look of the electronics industry today, the world of very large scale integration (VLSI) in which a wafer (enlarged here) measuring about three inches in diameter holds scores of circuit designs, each containing thousands of gates and each about one-tenth of an inch square. Comsat General Integrated Systems (CGIS) and Comsat General TeleSystems are playing an important role in today's electronics industry. Special Note: Wafer shown was processed using the services of SynMos of Palo Alto, California and was processed for ISI/DARPA.
Photo by William J. Megna.

From the Editor

Two articles in this, the seventh issue of Comsat Magazine focus on subjects that might be identified as pertaining to our central activity at **Comsat**, that is, providing satellite communication services—the article about our progress in winning approval for a Third East Coast Earth Station in Pennsylvania, beginning on page 19, and the one chronicling the fabrication of a single satellite in the Intelsat V family, beginning on page 25.

We have chosen to devote the largest amount of space, however, to some of the new activities of the Corporation, specifically the new activities of Comsat General Corporation, namely Comsat General Integrated Systems (**CGIS**) and Comsat General TeleSystems. We hope the reader will find the articles beginning on page 5 enlightening.

A word of thanks is in order to one member of the CGIS staff, based in Austin, Texas, for much help in connection with the article beginning on page 6. That staff member is Bob Billingsley, Manager, Advertising and Public Relations.

Stephen A. Saft

N O T E S

Third Quarter 1981 results are described

Comsat reported consolidated Net Income of $6,382,000, or 80 cents per share, for the third quarter of 1981. This was an increase of $238,000, or 3 cents per share, from Net Income reported for the second quarter of 1981, but a decrease of $3,173,000, or 39 cents per share, from the amount reported for the third quarter of 1980.

A major factor in the decrease of Net Income from the amount reported in the third quarter of 1980 was the planned higher costs related to Satellite Business Systems (SBS), which were $5,904,000 for the third quarter of 1981; they were $3,449,000 for the third quarter of 1980. These costs consist of Comsat's share of losses and amortization of certain costs relating to SBS, offset by related income tax benefits and investment tax credits. SBS is a partnership of Comsat General Corporation, IBM and Aetna Life and Casualty. It was established to provide advanced communications satellite services for a variety of users.

Also contributing to the decrease in Net Income from the amount reported for the third quarter of 1980, to that reported for the third quarter of 1981, was a $1,535,000 decrease in Net Operating Income. This resulted from planned increases in R&D expenses and in Operating and Maintenance expenses which, in part, represent increased costs of new ventures, including Satellite Television Corporation (STC). Also contributing to the decrease in Net Operating Income were reduced amounts for investment tax credits as a result of a change in accounting.

The Comsat Board of Directors has declared a quarterly dividend of 57.5 cents per share, payable on December 14, 1981 to shareholders of record on November 13, 1981.

Operating Revenues for the third quarter of 1981 totaled $84,909,000, an increase of $9,385,000 from the amount reported for the third quarter of 1980. Operating Expenses, including income taxes for the third quarter of 1981, totaled $74,776,000, an increase of $10,920,000 from the amount for the third quarter of 1980.

For the first nine months of 1981, consolidated Net Income was $32,635,000, or $4.08 per share, including the increase from a non-recurring item of $11,769,000, or $1.47 per share, in the first quarter of 1981. The non-recurring item resulted from a change to the flow-through method of accounting for investment tax credits on all property which is not public utility property. Consolidated Net Income for this period increased by $4,062,000, or 51 cents per share, over the amount reported for the same period in 1980. Income before the cumulative effect of the change in accounting policy declined in 1981, primarily because of the planned higher costs related to SBS.

Operating Revenues for the nine month periods for 1981 and 1980 were $244,440,000 and $217,756,000, respectively. Operating Expenses for the first nine months of 1981 were $213,388,000; for the first nine months of 1980 they were $185,621,000. Net Operating Income decreased by $1,083,000 from the amounts reported for the first nine months of 1980, principally as a result of the reduction in the current year amortization of investment tax credits resulting from the change in accounting, and planned increases in R&D and in Operating and Maintenance expenses.

TeleSystems, Harris set joint program in TDMA technology

The Satellite Communications Division of Harris Corporation and Comsat General TeleSystems, a subsidiary of the Comsat General Corporation, have launched a joint development effort in the field of digital communications.

The two companies, both leaders in satellite technology, will team to develop advanced Time-Division Multiple-Access (TDMA) products for private satellite networks. (For extensive

coverage of Comsat General Tele-Systems, see the articles beginning on pages 5 and 13 of this issue.)

Atlantic Richfield Company will use the jointly developed TDMA equipment in a satellite network, being constructed by Harris, that will link ARCO facilities in Alaska, Los Angeles, Denver, Dallas and Philadelphia.

In announcing the cooperative program, Bill Perigard, President of TeleSystems, said, "As more corporate communications networks begin to take advantage of the economies available through satellite communications, TDMA will be an important part of these future networks. The TDMA products we are developing will offer efficiencies and flexibilities heretofore unavailable."

Jack Rosa, Vice President-General Manager of Harris Satellite, said, "We foresee that TDMA will become increasingly important as the volume of data transmission continues to rise. Because of its ability to provide flexible, efficient control of communications networks, we see TDMA being specified by more and more customers. However, we also believe that Frequency-Division Multiple-Access, or FDMA, will continue to serve an important segment of the network market."

The significant difference between TDMA and other transmission techniques is the fact that with TDMA, each earth station takes its turn in transmitting to the satellite in a high-speed round robin fashion. The switching between stations occurs many times per second, so fast it must be controlled by computer. However, to the user it appears to be a continuous flow of signals.

Because only one station is actually transmitting at any instant, the satellite's full power can be used in relaying that signal to the other earth stations, improving transmission quality and reducing costs.

TDMA also allows the control system to vary the length of the separate transmission bursts to match traffic needs. If traffic from a station is light, the signal bursts from the station are shortened, while a busy station will be allotted larger bursts in the split-second round robin of transmissions. In addition, TDMA permits new earth stations to be added to a network by simply changing the controlling computer program.

Amplica Board gives approval to offer by Comsat General

The Board of Directors of Amplica, Inc., Newbury Park, California, has approved an offer by Comsat General Corporation to acquire all of the outstanding Amplica shares at a price of $13.50 cash per share, or an aggregate of approximately $57,000,000. The transaction would take the form of a merger, to be completed in early January 1982. The merger would be subject to certain conditions, including the approval of the holders of a majority of the common stock of Amplica. The principal shareholders of Amplica have stated their intention to vote in favor of the merger. Comsat General and Amplica are completing the terms of a merger agreement.

Amplica, a manufacturer of microwave amplifiers, is a publicly owned company whose shares are traded in the over-the-counter market.

Royal Navy leases Marisat capacity from Comsat General

Her Majesty's Royal Navy, United Kingdom, has contracted with Comsat General Corporation to lease satellite communications capacity on a Marisat Satellite. Under terms of the contract, UHF Service to the Royal Navy commenced 1 October 1981.

The multi-frequency Marisat satellites also provide service to the U.S. Navy at dedicated UHF frequencies, and to the commercial shipping and offshore industries at separate L-Band and C-Band maritime frequencies.

The Marisat System, developed and operated by Comsat General, is the

N O T E S

world's first maritime satellite communications system. Services to the international maritime market include telephone, telex, facsimile and data communications. **Comsat General** is a wholly owned subsidiary of **Comsat**.

President of STC comments on FCC's applications action

On October 22, the Federal Communications Commission made some key decisions about the disposition of the remaining 13 applications it has received for direct broadcast satellite (DBS) service. The FCC voted to return five of the applications as insufficient. It accepted seven of the remaining applications, and it accepted one in part and denied it in part. In addition, it established a period for comments on the eight accepted applications. The FCC had previously accepted the DBS application of Satellite Television Corporation (**STC**), a wholly owned subsidiary of **Comsat**.

Commenting on these decisions by the FCC, Irving Goldstein, President of **STC**, stated, "We are pleased that the FCC is pushing ahead with consideration of applications for direct broadcast satellite systems. **STC** is proud to have taken the lead in DBS; we filed the first DBS application 10 months ago, the normal public comment cycle on our application already has been concluded, and our application is ready for action.

"We are eager to move ahead with construction of satellites for DBS service, which we can initiate as early as 1985 if we have expeditious FCC action. Today's FCC action should enable the Commission to act promptly on **STC**'s application. We believe that American consumers desire this new service, and we're ready to go."

World Systems seeks to send full-time television to Australia

The Comsat World Systems Division has filed an application with the Federal Communications Commission to provide the first full-time satellite television service from the United States to an overseas location. The new service, scheduled to begin in the fall of 1982, will permit continuous video transmission from the United States to Australia.

An agreement had been reached earlier with Channel 9 Australia, Inc., a Los Angles-based subsidiary of Publishing and Broadcasting Limited of Sydney, Australia, to provide service for a period of five years with provision for extension. The Australian portion of the service is to be provided by The Overseas Telecommunications Commission (Australia), OTC(A), the international carrier in Australia.

Commenting on the new international service, Comsat World Systems President John L. McLucas said, "We at **Comsat** are quite excited about our reaching this milestone in the history of satellite communications. For the first time, a full-time television connection will be established between the United States and another continent half a world away. We are convinced that the Channel 9 Australia service is the forerunner of a new kind of international television service that will develop in the next few years."

Transmissions will originate from a Hollywood operation center, from which they will be fed by Channel 9 Australia to a specially-built satellite earth station at Santa Paula, California. The new earth station will be owned by the Earth Station Ownership Consortium, which consists of **Comsat** and American Telephone and Telegraph Company, RCA Global Communications, Inc., and Western Union International, Inc.

From Santa Paula, the television signal will be transmitted via satellite to an earth station at Moree, Australia, about 300 miles northwest of Sydney. The Pacific satellite is owned by the

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CGIS+TELESYSTEMS

on the move in the electronics, communications, information industries

by **Michael S. Alpert**, *Vice President, Communications and Information Products, Comsat General Corporation*

I am pleased that through the pages of **Comsat Magazine** we are able to tell the story of Comsat General Integrated Systems (**CGIS**) and Comsat General TeleSystems, two young organizations that I believe will play a significant role in the electronics, communications, and information industries. Both companies are part of the Communications and Information Products group of Comsat General Corporation, a wholly owned subsidiary of **Comsat**. Both are in their early stages of development, entrepreneurially driven, and product/market-oriented.

Indeed, both **CGIS** and **TeleSystems** have been strategically positioned to play important roles in the revolution that is taking place in electronics and communications today—the marrying of electronic communications and information processing. The following articles provide highlights of these two new additions to the Comsat family.

CGIS is **Comsat**'s entry into the computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided test (CAT) industry. It has been projected that this industry will grow from $750 million in 1981 to over $8 billion by the end of the 1980's. It is believed that CAD/CAM will change the manufacturing process as fundamentally as the assembly line did.

In its role as a satellite systems builder, **Comsat** has directly experienced the problems encountered during the design, manufacture and testing of complex electrical products and systems. Accordingly, **CGIS**'s business strategy addresses these problems and focuses on a special niche in the CAD/CAM marketplace—the digital and microwave areas of the electronics industry. **CGIS**'s future growth plans center around two proprietary application software packages that were obtained when **Comsat General** acquired Compact Engineering of Palo Alto, California and its COMPACT family of products, and Comprehensive Computing Systems and Services (CCSS) of Austin, Texas with its TEGAS software packages. In addition to offering individual applications and system software products, CGIS will provide integrated turnkey systems consisting of these products with engineering workstations, computers and related peripherals, and local area networks.

Because of the new directions in which **Comsat** is heading (i.e., CAD/CAM, direct satellite-to-home television, and environmental information services), the continued development of communications technology and information systems plays an important role. As a result, **Comsat** has made a strategic decision to enter the equipment business and manufacture products for use by both outside and internal customers. Comsat General TeleSystems was **Comsat**'s first entry into this equipment business.

TeleSystems' market niche is the digital electronics portion of the telecommunications market. The company has enjoyed considerable success with its family of echo cancelling products, and has delivered over 13,000 echo cancellers over the past two years. **TeleSystems** will be introducing both a very-large-scale-integrated circuit (VLSI) version of the existing canceller and a multichannel digital canceller in early 1982. **TeleSystems** is now in the midst of broadening its product lines to include Time-Division Multiple-Access (TDMA) equipment and shipboard terminals to work with the MARISAT/INMARSAT systems. The company also is planning related products that will work together to form an integrated communications network between the satelite earth station and the user's premises.

Recently, **Comsat General** announced its intention to acquire Amplica, a manufacturer of microwave amplifiers. We look forward to welcoming Amplica to the Comsat family and expect its contributions will enhance **Comsat General**'s manufacturing capabilities.

This brief description of both **CGIS** and **TeleSystems** suggests that both organizations are moving forward aggressively, but with a planned strategic focus, within a truly exciting sphere of the electronics business. The level of creativity, energy, and personal commitment of the highly motivated employees in both companies makes them worthy, I believe, of being part of the dynamic satellite communications business—part, that is, of the company that is the leader in that business, **Comsat**.

SOFTWARE AND SYSTEMS FOR THE ELECTRONICS INDUSTRY

CGIS

by **Stephen A. Saft**, Editor, Comsat Magazine
Photography by **William J. Megna**

Comsat General Integrated Systems, Inc. (**CGIS**), **Comsat General**'s new subsidiary, starts life with two very successful software products, TEGAS and COMPACT, among its roster of things to sell, but to understand what **CGIS** is about takes much more than an understanding of the applications and benefits of these two products. To understand **CGIS**, one must come to grips with four phenomena of modern technology.

Phenomenon number one is the continuing successful miniaturization of electronic products with ever enlarging capacities. Second is the growing importance of the computer as an aid in the designing, testing and manufacturing of electronics and other products. Third is the burgeoning profusion of computer hardware and software, a confusing profusion, one must add. Fourth is satellite communications. For **CGIS** was created to impact all four and, indeed, to impact all four in a coherently logical way.

It takes no technologist to realize that our electronic products are doing more while getting smaller all the time. In the palm of a hand, one can carry a device—a computer—with sufficient computing power to perform on a par with mainframe computers of a few years ago. In that same palm, one can carry a radio or a tape recorder that is a fraction of the size of the smallest machine of its type marketed 10 years ago.

Our wristwatches no longer need hands. Their complex miniaturized electronic innards incorporate liquid crystal displays that provide digital readouts of time, day and date, plus stopwatch functions, alarms and more. And consider the growing proliferation of toys that literally seem to think.

CGIS is not in the business of manufacturing electronic products such as these or the components inside them, but its work has everything to do with the way such products are designed and developed. And, hence, **CGIS** plays a vital role in the driving compulsion of the electronics industry to cram more and more functions into less and less space. For one of the things that **CGIS** does do—the very root of its business as represented by its software products TEGAS and COMPACT—is to conceive, develop and market computer-aided design (CAD) tools and computer-aided test (CAT) tools for the electronics industry in the digital and microwave areas and to provide all the necessary support data needed for the computer-aided manufacture (CAM) of such products.

Born in the 1970s to help speed the process of design through manufacture of complex parts in the aerospace industry, CAD, CAM and CAT techniques are today used not just in the aerospace industry but in the automotive industry and for architectural design and civil engineering and in the electronics industry. For most of those serving as suppliers of the technology, growth has been enormous, and the potential appears enormous as well.

The President of **CGIS** is Dr. Stephen A. Szygenda, who operates the organization out of offices in Austin, Texas. Dr. Szygenda explains the importance of CAD, CAM and CAT tools to the electronics industry this way: "In the past, we designed and built computers and other electronic products without these tools. So the logical question today is, 'Why can't we continue to design and build these products in the same way?' The answer is simple: 'Complexity.' You cannot do it. When the designer was designing small-scale integrated circuits (SSI) and medium-scale integrated circuits (MSI), he was talking about relatively small pieces of logic, maybe 50 to 300 gates. He could draw a picture of his design, look at it and pretty much comprehend what was going on. But today we're talking about tens of thousands of gates on a silicon chip that's one-tenth of an inch square. The human mind cannot comprehend the interactions of components at that level.

"Circuit complexity and rising production costs are the driving forces that make CAD, CAM and CAT so important," Dr. Szygenda adds. "Our

goal at CGIS is to exploit potential across a broad front by automating not only the fabrication process but also the design, testing, expediting and support function as well, and then by integrating these processes to provide a full range of software, hardware, service and support products.

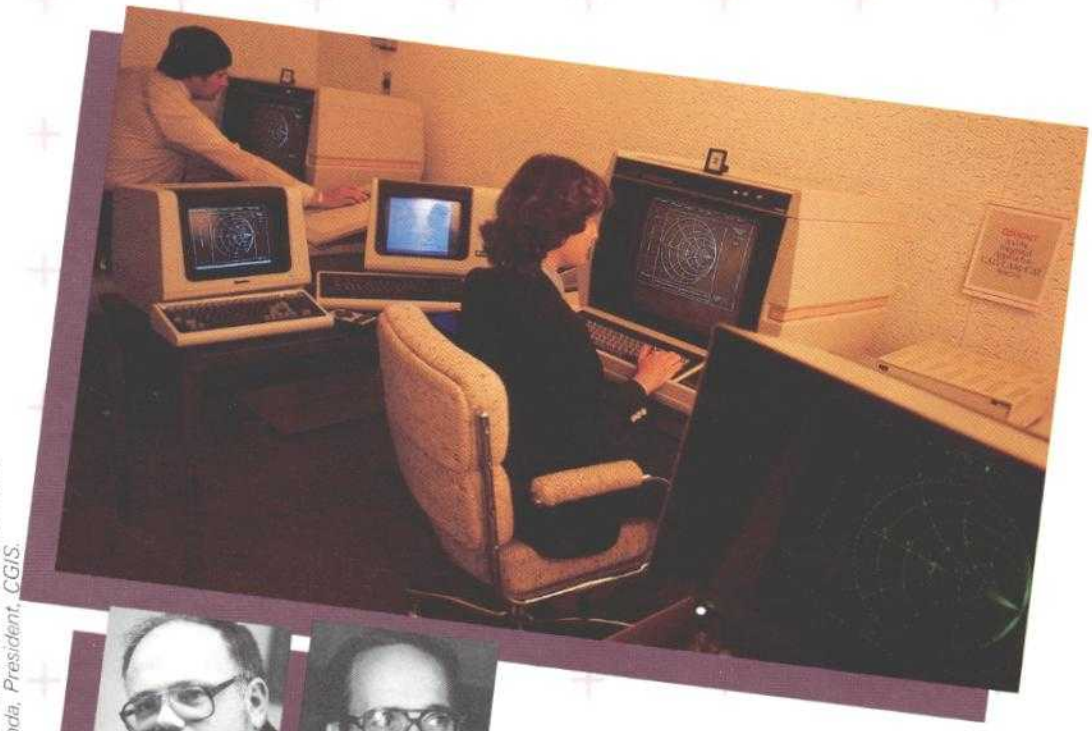
"We're well on that path now, and we fully expect to establish CGIS as the premier CAD/CAM/CAT corporation. For our growing customer base, which now numbers over 300 companies, the CGIS approach simplifies their concept-to-finished-product cycle."

David Rager, Vice President of Marketing, also based in Austin, amplifies on the importance of CAD, CAM, CAT tools in the new area of electronics, the era of large-scale integration (LSI) and very-large-scale integration (VLSI). "On an integrated circuit chip which may have thousands of components on a surface that measures a tenth of an inch by a tenth of an inch, you can't go in and look at any particular component. And the cost of developing the chip can be on the order of $50,000 to $100,000 and take as long as two years. When you've gone to this much expense and invested this much time, you don't want to fabricate the product and find out only then that you've designed it incorrectly. In cases like this, it's of tremendous benefit to be able to use a computer program to determine that the circuit design is correct before you actually implement the design."

Miniaturization is taking place not just with digital or logic devices but with microwave circuits, which operate in the analog mode. Les Besser, CGIS Senior Vice President and operating head of the CGIS facility in Palo Alto, California, including the Compact Division, states, "Today, a large percentage of microwave circuits are produced in an integrated form. If you should find a design error, you may have to throw out the whole circuit. Hence, it is very important in the design stage to predict the performance before you go ahead with fabrication. Microwave design engineers have come to realize that it is extremely beneficial to use computer-aided design, that common sense dictates that it is faster and cheaper to verify performance or try alternatives on a computer rather than to try and accomplish the same thing on a workbench."

As software products, the CAD, CAM and CAT tools created by CGIS are dependent on hardware—specifically computers—for presentation in usable format to the user. But the array of hardware is proliferating, and one unit is often not compatible with another in terms of its software requirements. Faced with repeated examples of hardware-software incompatibility, perplexed computer users are increasingly turning to third-party companies to engineer total hardware-software systems. As a key software supplier, CGIS wants to

Headquarters for CGIS is in Austin, Texas. Two profit centers—the Digital Division and the CAD, CAM, CAT Services Division—are based in Austin as is Marketing and Finance and Administration.



Above, the Demonstration Room at CGIS's Palo Alto, California, facility. Here the ability of the SUPER COMPACT software product to work with a wide range of graphics terminals can be demonstrated. Below, left, Wayne D. Brown, Chairman, and, right, Dr Stephen A. Szygenda, President, CGIS.

position itself to offer a total service. Hence, the words "integrated systems" in its name. And **CGIS** is prepared to carry its systems approach far enough to encompass multiple terminals in scattered locations accessing multiple computer resources. Thus it is prepared to establish what are called "local area networks" for data transmission and processing and to proceed with development through to the next logical step: linking multiple local area networks via satellite.

Wayne D. Brown, Chairman of **CGIS** and based at its Palo Alto, California, facility, has nurtured the CGIS concept, including its reliance on systems integration as the keystone, since his days at the Hughes Aircraft Company in the 1960s and 1970s and then later as Director of West Coast Operations for **Comsat**. He says of the reasoning behind the CGIS system approach, "There are so many computers and software packages available that it is a bewildering array of technology for most users. The end user, totally confused, feels that he needs bits and pieces of these systems, and somehow he has to get all the pieces working together. And so a very important part of our job is to be aware of all of these tools and bring them into focus, to integrate them in such a way that the end user knows that the ultimate system will solve problems—not create them. The typical user is not a computer expert, has no desire to become a computer expert, but he has a job to do. And our task is to present computer tools in such a way that they're nonfrightening, that they are very friendly."

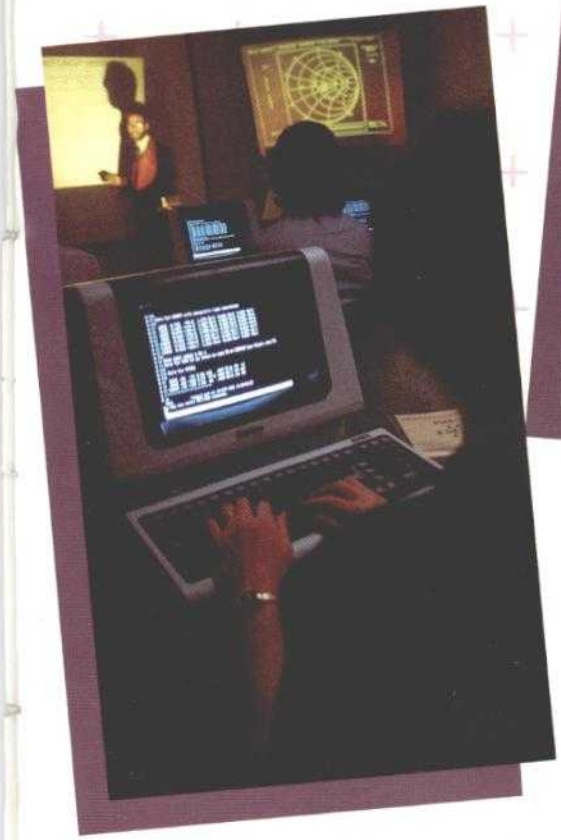
Ultimately, the most efficient use of the data bases created through CAD, CAM and CAT approaches and dispensed through a local area network within an organization is by linking the local area networks of the entire organization, Wayne Brown believes. "Many companies," he says, "are geographically dispersed. They may have an engineering activity in one location, a manufacturing activity in another and a corporate headquarters somewhere else. Each one of these divisions needs its own computer-aided tools, but then those divisions need to be tied together into one integrated network. That's where satellite communications comes into play. **CGIS** has a role to play at each of these individual locations, and we're being instrumental in catalyzing satellite networking of data communications on an organization-wide basis."

The organization that today is **CGIS** started life in 1979 as Integrated Design and Manufacturing Systems (IDMS) and then set forth to acquire the kind of talent and know-how necessary to fulfill Wayne Brown's demanding commitment to providing industry with first-rate CAD, CAM and CAT tools and first-rate systems that use those tools. In November 1980, Les Besser brought his Compact Engineering, Inc., which began selling the COMPACT family of CAD software in 1973, into the fold, and a short time later—January 1981—Dr. Stephen Szygenda brought in Comprehensive Computing Systems and Services, which began selling TEGAS CAD software in 1972. In November 1980, the organization that had been known as IDMS changed its name to Comsat General Integrated Systems.

Today **CGIS** is structured into four profit centers (Digital, Services, Compact & Systems Divisions) and three support groups. Two profit centers, the Digital Division and the CAD/CAM/CAT Services Division, are based in Austin as is Marketing and Finance and Administration. The development and support of software products such as TEGAS, which stands for Test Generation and Simulation, are the responsibilities of the Digital Division. The CAD/CAM/CAT Services Division is responsible for Regional Technology Centers in Austin, Palo Alto; Rockville, Maryland and Pompano Beach, Florida.

Palo Alto is headquarters of the Compact Division, which develops and supports software products for the design of analog high-frequency and microwave components, and it is home of the Systems Division, whose job it is to design the kinds of integrated system which use software products like TEGAS and COMPACT as basic building blocks. The support group at Palo Alto—Operations—includes among its tasks the actual engineering of systems designed by the Systems Division.

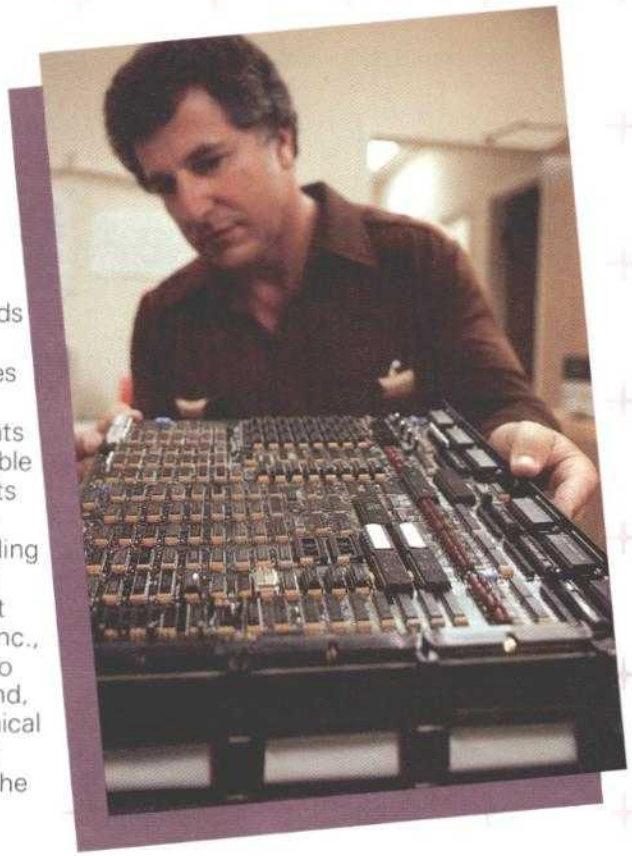
Head of the Digital Division is Dr. Ed Thompson, CGIS Vice President, who came to the organization along with Dr. Szygenda when Comprehensive Computing Systems and Services was acquired. Ron Dorst is CGIS Vice President and head of the CAD/CAM/CAT Services Division. Also in Austin are Erling P. Fossum, Vice President, Finance and Administration, and Gary Thomas, Vice President and General Counsel.



***Below left,** Training Room in Palo Alto used by both CGIS and SynMos, Inc. Every student has an operating terminal. **Below right,** view of CGIS computer room in Palo Alto.*

Les Besser, as previously noted, is CGIS Senior Vice President and Chief Operating Officer of the Palo Alto facility. Head of the Systems Division is Randy L. Prakken, Vice President. Operations is headed by Jarin Feldstein, Vice President.

Ron Dorst says this about the Regional Technology Center concept: "The centers will have the primary responsibility of supporting our products and our customers. Through these



Microprocessor intelligence board is the electronic heart of the CGIS Palo Alto Local Area Network in which any one of 100 terminals can access seven different computers from four different manufacturers.

centers we will achieve maximum responsiveness to our customers' needs by providing product demonstration and training, plus consultation services and customer support."

Through cooperative arrangements with co-located companies, **CGIS** is able to offer still more services. Through its association with Applied Silicon Technology, Inc., located in the same building with **CGIS** in Austin, **CGIS** provides a full range of custom integrated circuit design and layout services. SynMos, Inc., in the same building with **CGIS** in Palo Alto, offers courses in VLSI design and, in addition, has developed an economical method of manufacturing VLSI chips through a shared-silicon technique. The SynMos approach allows multiple integrated circuit designs to be processed simultaneously on a single silicon wafer.

As **CGIS** pushes to develop its systems capabilities, it does not neglect the basic building blocks of its business. For example, TEGAS is now in its fifth generation, and the Digital Division development people are hard at work perfecting TEGAS-6. TEGAS basically provides four key benefits for the designer and manufacturer of digital components and circuits—logic verification, design verification, fault simulation and test generation.

Dr. Ed Thompson explains: "TEGAS doesn't help create the design, but once the design is completed, TEGAS answers the question, 'Is the design correct? Does it really do what it is supposed to do?'"

A description of the design, called the design topology, is programmed into the computer. TEGAS then simulates the logic of the design. Thompson explains, "What the simulator will do is to say, 'If you apply these values as inputs, this is what you will get as outputs.' The engineer can examine the results and know immediately that the design is or is not correct. The TEGAS simulator provides values on all intermediate signals, and the designer can trace back through the circuit until he finds the error. So, with TEGAS, we can discover where we made a mistake without ever having to go to the expense of building a prototype or breadboard of the design."

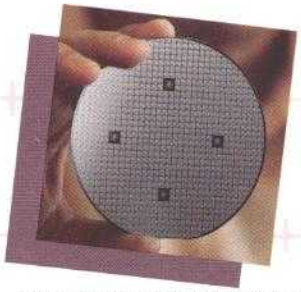
That is the logic verification function of TEGAS. The design verification function is used to find timing errors in the design, or what are called "races." In fault simulation, TEGAS is used to determine whether a set of manufacturing tests or a specific design are adequate. This is done, as Thompson describes it, by "modeling physical defects."

Finally, TEGAS can be used to generate a magnetic tape that will drive the testing machines in the electronics manufacturing plant. In effect, TEGAS programs the tester to look for specific errors.

In addition, according to Thompson, TEGAS can be used to generate diagnostic tests for specific designs in which output failures can be attributed to specific faults.

Initially, TEGAS was not a graphics system. But through CGIS growth and because "integration" is a key element in the CGIS approach, TEGAS now has a strong graphics component called LOGIX. This TEGAS-compatible product provides the graphics display capability that assists the engineer in the complex tasks of logic design.

Another new product of the Digital Division is COMETS, which stands for Comsat Enhanced Timing Simulator. COMETS determines the timing delays in an entire circuit design and, as a result, tells the design engineer what the timing requirements are.



Production wafer containing several hundred of the same circuit generated using methodology created by SynMos, co-located with CGIS in Palo Alto and with whom CGIS cooperates on many projects. SynMos approach is called "shared silicon technology (SST)."

The Compact Division of **CGIS** also is looking at a graphics companion for its software products and will offer those products in 1982.

TEGAS and COMPACT and its more advanced version, SUPER COMPACT, have as software products certain general characteristics in common, but they are also quite different. Says Les Besser, head of the Compact Division, "TEGAS works in the digital world of ones and zeros, while COMPACT and SUPER COMPACT deal in the analog world with everything from zero to infinity. TEGAS deals with large circuits containing thousands of relatively simple components. COMPACT deals with circuits with only a small number of very complex components."

In a demonstration, Besser showed how SUPER COMPACT could direct the design of a broadband microwave amplifier containing seven different variable components where uniform gain was desired over a frequency range of zero to two gigahertz. First, the user of the system merely guessed at the values of each component—capacitors, inductors and resistors. Then he asked SUPER COMPACT to plot the gain of the amplifier. The CRT plot revealed a gain line that looked somewhat akin to one of the faces of Mount Everest. Clearly, were this amplifier ever to be built, its performance would be totally unsatisfactory. Besser then asked SUPER COMPACT to change the component values so that uniform gain could be achieved. In a few seconds, the optimized values for the seven variables appeared on the CRT screen. SUPER COMPACT was then asked to show what the gain would be for this modified amplifier design. When the optimized gain response appeared on the screen, it looked almost as straight and smooth as an ice skating rink.

SUPER COMPACT is actually one of a family of COMPACT software products for the design of high frequency and microwave products. The most powerful member of the family, it is meant to be run on large computers or big minicomputers. MINI COMPACT is the version designed for operation with standard minicomputers. MICRO COMPACT runs on desk-top computers, while HANDY COMPACT is for hand-held, programmable calculators.

In addition, the CGIS Compact Division is responsible for FILSYN, a product dedicated to the task of designing microwave filters. Recently the Compact Division introduced SUPER-SPICE, a modified and more powerful version of a software product first developed by the University of California at Berkeley for the design of low-frequency analog circuits.

One of the most interesting development projects for the staff of the Compact Division involves a microwave test station that uses software for tuning microwave components. Says Les Besser, "This product could be quite a breakthrough for the microwave industry. At many companies making microwave components, the person charged with tuning up the components is considered more important than the company president. Right now the whole activity is much more art than science. We plan to lower the required skill levels of the operator by having the computer make more of the critical decisions."

Yet another of Besser's upcoming products is MODART, a software program that converts microwave component models to artwork form that is then used in subsequent manufacturing and fabrication processes.

The task for the CGIS Systems Division is not simply to marry CAD/CAM/CAT tools like TEGAS and COMPACT with hardware. Often dedicated ancillary hardware and software systems must be developed and incorporated to tailor-make the system to an individual customer's needs.

The achievement the Systems Division is building upon is what it has accomplished in its own Palo Alto facility. Here every employee, including Chairman Brown, every engineer and every secretary, has a CRT terminal on his or her desk. There are about 100 such terminals in all. From any of those terminals, the seven different computers from four different manufacturers can be accessed.

The man who managed the assembly and installation of the system is Jarin Feldstein, "From my desk I can connect to any of our seven computers—without hardware changes—without physical connection changes," says Feldstein. "I don't have to change my terminal configuration, even though the four different computer manufacturers have their own

protocols. Without this network, if I wanted to be connected through the same terminal to another computer, in all probability, I would have to change the physical setup of my terminal and the physical interconnections to the desired computer. The network we have installed, the CGIS network, takes care of that for us."

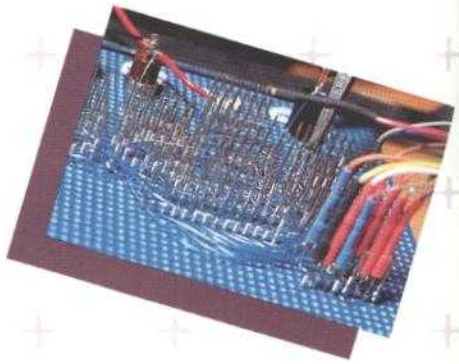
Key to the CGIS Palo Alto local area network is a Systems Division product called NOEL, which stands for Network Operations Environment and Language. Dr. Barry Goss, Vice President for Technical Planning, explains: "It's a software product, a very user-friendly software product that has the ability to communicate with a multiplicity of machinery. It moves files between processors in a very user-friendly way. I no longer have to worry about the language that each computer speaks. I only have to speak the NOEL language. By design, NOEL is understood by all of my computers."

An important feature of the CGIS Palo Alto system is word processing and text editing. Not surprising, text processing is a key element in several large programs being developed for CGIS customers. In these programs, integration is often the central element—the integration of terminals, word processing, and CAD/CAM/CAT capabilities.

Randy L. Prakken, head of the Systems Division says, "These systems provide tremendous productivity improvements for our customers. They pull together the entire design process and make theoretical analysis activities and design and layout activities relate directly to each other."

"Productivity" is the key word at **CGIS**. Randy Prakken said it. Steve Szygenda talks of increased productivity through CGIS products. Les Besser is tuned to the need for productivity gains. Ed Thompson's digital products are designed for the customer who wants to raise his productivity. Putting productivity in the context of all the strengths of the young and vital CGIS organization, Steve Szygenda states, "In **CGIS**, customers have a single source of design, test and manufacturing help. They no longer need to fit those pieces together from myriad vendors and then hope for some acceptable degree of compatibility. Using our integrated systems, customers can increase productivity, save engineering, testing as well as manufacturing time and produce highly competitive products."

Wayne Brown adds, "**Comsat** in total and each of its elements taken alone are in a position to contribute enormously to productivity enhancements as a result of our combined experiences in networking, satellites, communications and CAD/CAM/CAT. **CGIS**, **Comsat General** and the diverse elements of the Comsat family are moving inexorably in that direction. It's exciting to be part of that effort."



Below left, *CGIS software as represented by computer in background, keyboard/printer terminal and magnetic tape aids in the design (represented by integrated circuit chip art, center), manufacture and test of electronic products, foreground, including man's wristwatch.* ***Below right,*** *CGIS computer simulation approaches eliminate need for much "breadboarding" such as that shown here. Photo right by George I. Kurachi, Jr.*

MAKER OF ELECTRONIC PRODUCTS

TELESYSTEMS

by **Ivan H. Riley**, *Director, Market Planning and Development, Comsat General TeleSystems*
Photography by **William J. Megna**

Product is an overused and ubiquitous generalization common in today's business language. Nevertheless, it is the key word that finds frequent use in any description of the business of Comsat General TeleSystems. Products can be something as tangible as a box of cereal, something as ethereal as a computer program, something as complex as an airplane, or something as intangible as banking services. The list is virtually endless, but they all seem to have two common characteristics. Products are sold in a competitive, open market, and they are produced repetitiously so that the economic advantages of scale accrue to the producer. These two common characteristics very precisely describe the business of **TeleSystems**.

The creation of a product-oriented subsidiary within the Comsat family is a departure from the company's older lines of business, yet it was a natural evolution. Planning for the creation of **TeleSystems** began in 1978, and the company was incorporated as a wholly owned subsidiary of **Comsat General** in April of 1979. In January of 1980, **TeleSystems** moved into 50,000 square feet of new facilities located in Fairfax, Virginia—about 15 miles west of **Comsat**'s downtown Headquarters in Washington, D.C.

Comsat's position as one of the world's leaders in developing communications technology, its intimate involvement with the leading manufacturers of communications equipment, has throughout the years revealed to its staff certain technology voids in the telecommunications equipment manufacturing business. Further, with the new directions the company has undertaken, other needs relating to telecommunications equipment also became evident. Thus, the natural conclusion was to create a subsidiary which could and would manufacture products both for use by the Corporation and for use by the outside world.

TeleSystems has set out to concentrate on the terrestrial side of satellite communications in order to achieve the economies of scale required for a successful product endeavor. Accordingly, **TeleSystems** decided that it would not become involved in the manufacture of spaceborne equipment or would not initially develop radio frequency or RF products. This decision was motivated by the desire to initially concentrate the new company's resources toward achieving an expertise in a single generic area of satcom technology.

TeleSystems' initial market niche is probably the most rapidly evolving and exciting part of the entire telecommunications industry. It is characterized as "below RF, earth-based systems." It can more aptly be described as the digital electronics portion of the telecommunications market. This marketplace is bubbling with new applications, innovations, and technological breakthroughs. It is the world where diodes emit light; 20,000 circuits can be put on a silicon chip no bigger than the end of a pencil; and operations are controlled by matchbook-size microprocessors which do the computational work done by a room full of computers a scant 20 years ago. This is the marketplace where **TeleSystems** has developed its expertise, invested in facilities and positioned its products.

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A.W. Perigard is President of Comsat General/ TeleSystems based in Fairfax, Virginia

TeleSystems' initial product offering is a series of rather esoteric devices called echo cancellers. Anyone who frequently makes long-distance calls has probably noticed an echo on the line—sometimes at rather distracting levels. Because of the long propagation delays associated with satellite communications, echo can be particularly disturbing. Many times an echo is not heard, but the telephone user notices the first syllables of words being clipped off and sudden level variations—particularly if both parties speak at once. These latter degradations are caused by a device known as an echo suppressor. The echo canceller solves all of these problems. Through the use of very sophisticated digital signal processing techniques, it eliminates echo and offers an effective alternative to echo suppression and its undesirable side effects.

Today, **TeleSystems**' line of echo cancellers includes the EC-4000, which is applied to single analog telephone circuits, and the EC-5000, which is applied to multiplexed digital circuits and simultaneously cancels echo on 24 or 30 telephone channels. Customers for these products include communications common carriers, both domestic and international, and large corporations who maintain their own private telecommunications networks.

The digital signal processing algorithm, which performs the echo cancelling function, requires use of upwards of 30 separate integrated circuits. Because of the power consumed by these ICs and their cost, **TeleSystems** has designed a special-purpose very-large-scale integrated (VLSI) circuit to replace these multiple ICs. This VLSI chip, sometimes called the echo canceller on a chip, is at the very forefront of semiconductor technology and will assure that **TeleSystems** maintains its leadership in echo canceller technology. The VLSI chip will be used in **TeleSystems**' echo cancellers beginning in early 1982. Of equal importance, several of the world's leading manufacturers of telephone switching equipment are exploring programs which will lead to building the chip into their switches.

Although the echo canceller and the resulting peripheral equipment has proven to be an excellent choice for **TeleSystems**' first product line, and still accounts for the majority of revenues, the plan of the company is to move vertically into the systems business. This strategy of vertical integration will allow **TeleSystems** to offer its products as a packaged solution with favorable economic terms. A good example of this strategy is **TeleSystems**' latest product offering, the DST-1000 system.

TDMA, which stands for Time-Division Multiple-Access, is a technique for increasing the efficiency of satellite communications networks and introducing degrees of flexibility into such systems that were heretofore impossible. With TDMA, each earth station in a network is assigned a time interval in which the station sends its information. Each station has its own time interval, and transmissions proceed in a round robin fashion. The technique is entirely digital and has been known for many years. Only with recent advances in digital processing technology has it become economically feasible. **Intelsat** will begin using TDMA in 1984, and many domestic and private networks can be expected to take advantage of it within the next few years.

The TDMA subsystem is only a part of a communications satellite earth station; it interfaces with the frequency converters, power amplifiers and receivers on one side, and terrestrial interconnecting facilities on the other side. It is, however, the central part and provides the network with intelligence. It also controls all functions of the satellite network, the most significant of which is routing. If designed with the proper forethought, the TDMA equipment can perform the functions of a large, distributed tandem switch. It can route calls from any earth station and its interconnecting facilities to any other earth station and its interconnecting facilities. It can even do this on a call-by-call basis just as is done in a telephone company central office. In fact, the only important difference between this type of TDMA-controlled satellite network and a typical telephone company switching center is geographic dispersion. The TDMA network terminates in telephone circuits connected to earth stations spread over a wide geographic region; the conventional telephone circuit switch terminates with telephone circuits in one location only. The new DST-1000 from **TeleSystems** is being designed to perform these distributed switching functions, and, in the coming years, it will be the heart of new "switching systems in the sky."

The DST-1000 is the architectural

cornerstone of **TeleSystems**' vertical integration strategy, providing the company the means to move into the complementary satcom digital equipment (e.g., voice compressors) and eventually toward the digital electronics portion of the terrestrial interconnecting facilities. In addition, there are many opportunities for the natural extension of products into the terrestrial communications market, thereby further expanding the available economies of scale.

In addition to the efficiencies offered by the DST-1000, it is possible through optional digital encoding of voice signals to obtain additional efficiencies. Present telephone technology encodes a voice signal into a 64,000 bits-per-second digital stream. Through the use of voice compressors that **TeleSystems** will offer in 1982, a voice signal can be economically encoded into a 32,000 bits-per-second stream. In the not too distant future, 16,000 bits per second will be possible. On top of the savings obtained through encoding, other economies are possible through use of Digital Speech Interpolators, which take statistical advantage of the one-way nature of most conversations and of the natural pauses in speech, to assign an idle period on one channel for use by another. Use of this advanced digital technology will increase satellite system capacities by a factor of either two or four and someday by a factor of eight. Each of these techniques has only now become economically feasible because of the recent advances in digital signal processing technology.

In order to utilize the techniques described, it is necessary to convert from commonly used analog channelizing techniques (most terrestrial transmission systems are analog) to digital channelizing techniques and vice versa. A device called a transmultiplexer, that makes these conversions to large groups of channels simultaneously, is under development at **TeleSystems** and will have applicability not only to satellite communications systems but also to newly emerging terrestrial digital communications systems.

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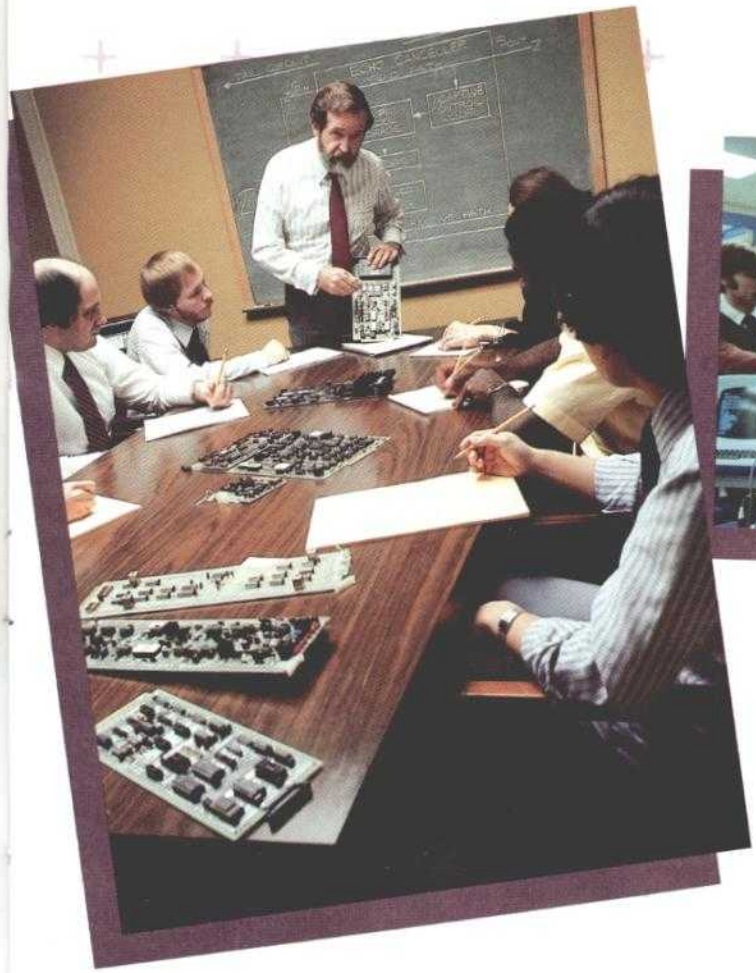


***Left,** Jim Durham, Manager of Engineering Services, explains improved features of new VLSI echo canceller, the EC-4500, during final design review. Three generations of echo control devices are pictured in foreground. **Right,** Controller Status Panel and Orderwire are shown in the final configuration of the local station DST-1000 TDMA terminal.*

Top, view from the end of "slide line" printed circuit board assembly operation. "Slide line" is located in TeleSystems' 35,000 square foot manufacturing facility in Fairfax. Right, designer is shown using refresh graphics terminal of TeleSystems' computer-aided design (CAD) system. Output of operation is very accurate, automatically prepared artwork and a series of digitized tapes used to manufacture product.

Further opportunities for vertical integration exist in interfacing data communications networks to satellite systems. Development is under way for a product line of data controllers which will connect a wide variety of data networks to satellite networks and provide the necessary multiplexing and protocol conversions.

A somewhat different facet of **TeleSystems**' personality is the company's involvement with maritime ship terminals. Since the beginning of the Marisat program, **Comsat General** had been selling and servicing shipboard terminals produced by an outside manufacturer. As technology both in maritime communications and basic signal processing advanced, it became apparent that a new lower cost shipboard terminal was entirely feasible and that such an approach would make the terminals available to another segment of the ship terminal market that had previously been precluded from buying as a result of the high price. Further it was believed that such action would have a positive impact on the growth of maritime satellite communications and on the newly created Inmarsat organization. In late 1980, **TeleSystems** assumed the responsibilities for the sales and service of ship terminals and began development of the new terminal. This new ship terminal, the MCS-9000, is scheduled to be available in the summer of 1982.

The MCS-9000 will be more compact, more reliable, require less power, and cost far less than its predecessors. Its design has taken full advantage of **TeleSystems**' digital electronics expertise, but RF electromechanical and structural components such as amplifiers, receivers, autotracking pedestals and antennas have been bought from other manufacturers and packaged by **TeleSystems** to meet system level requirements. **TeleSystems** will integrate and test the entire terminal prior to shipment and will assume complete responsibility for the terminal's performance. Nor will **TeleSystems**' ship terminal development activity stop with this design iteration. Already included in the present software architecture and planned for hardware implementation are an interface for high-speed data

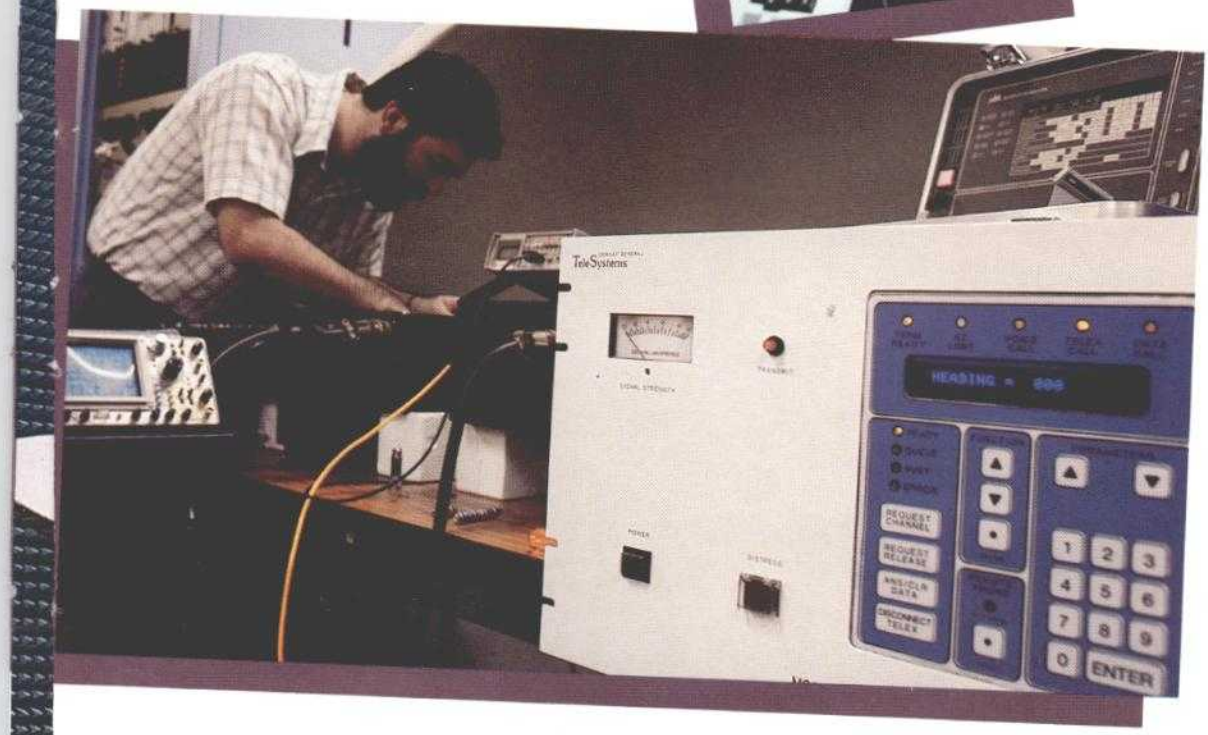
transmission and shipboard PBX. In addition, the next total terminal iteration has been conceived and planned and includes a smaller, less costly antenna and pedestal and redesign of the RF package that takes advantage of microwave integrated circuitry (MIC), thereby increasing system reliability and reducing cost. These continued development activities, together with our worldwide service, maintenance and installation capability, promise to bring **TeleSystems** to the forefront of the maritime satellite communications business.

While the emphasis in this article has been on **TeleSystems**' products, what they do and how they fit in the marketplace, it is only a part of what **TeleSystems** is all about. **TeleSystems** is a complete company, made up of modern facilities and equipment but—most importantly—of energetic, motivated people who are keenly aware of the competitive nature of their endeavors. TeleSystems products must be manufactured efficiently and sold competitively. The cleverest product conception and development is doomed without proper attention to the competitive environment.

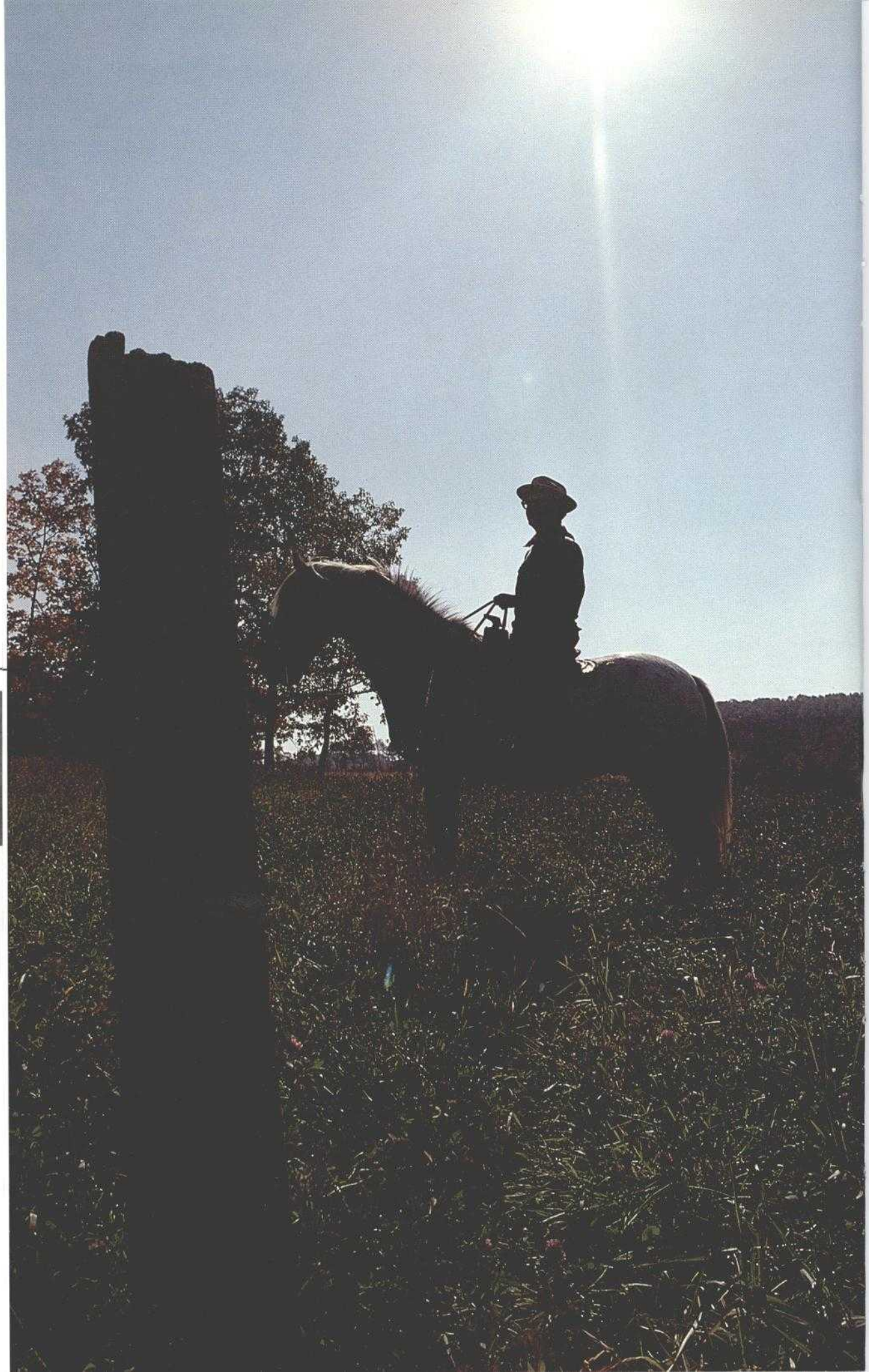
TeleSystems is a marketing-oriented company and its products have been developed by an engineering staff that pays attention to customer requirements, system architecture (and thereby product economies), manufacturing and test methods, and technology.

TeleSystems manufacturing facilities are among the most advanced available and include extensive equipment for automated assembly and test. Reliability and efficiency are the bywords in **TeleSystems**' manufacturing operations.

This, then, is a picture of **TeleSystems**. It is a product company with an organization capable of selling and producing. The initial investments in the company have been made and the course has been set. Although its future is by no means assured, the prospects are bright. Over the ensuing years it will be a company well worth watching, and we invite you to watch with us in future articles.



***Below,** TeleSystems' MCS-9000 Maritime Satcom Terminal shown during a portion of type acceptance testing. Complete below decks module is pictured in foreground while development engineer performs measurements on RF module. **Above,** member of technical staff is seen verifying critical performance parameters during software/hardware integration of DST-1000 TDMA terminal.*



PENNSYLVANIA

WE'RE GETTING CLOSER

With approval of Cleveland Township Zoning Hearing Board, Third East Coast Earth Station moves closer to reality.

by **Robert W. Kinzie**, Vice President, Satellite Systems and Technology Group, Comsat General Corporation. Photography by **William J. Megna**.

A major milestone was achieved in progress toward the construction of World Systems Division's Third East Coast Earth Station when the Zoning Hearing Board of Cleveland Township, Pennsylvania granted the requisite approvals for construction of the facility. Thus, a key step, the acquisition of suitable land—a 107-acre farm owned by Mr. and Mrs. Warren (Jim) Watkins—with the necessary local approvals, has been achieved.

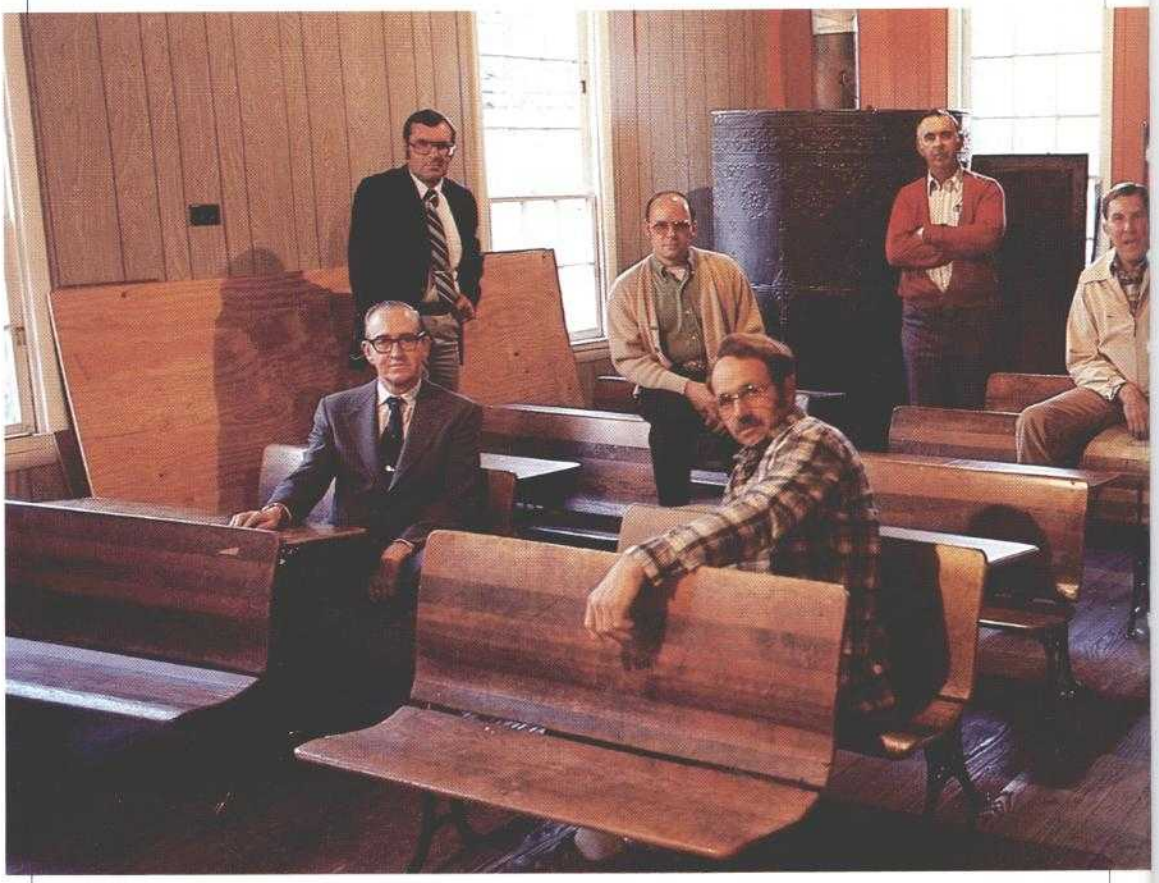
The new earth station complex will consist of an Intelsat Standard A earth station with a 32-meter (105-foot) diameter beam waveguide antenna for dual-polarization operation at 6/4 GHz, and an Intelsat Standard C earth station with a 32-meter diameter beam waveguide antenna for operation at 14/11 GHz. A third 32-meter diameter beam waveguide antenna, fitted with a dual-frequency feed, will provide backup for both the 14/11 GHz and 6/4 GHz operational antennas. The backup antenna will also provide restoration capabilities for other East Coast earth station antennas under certain failure conditions.

Locating a suitable site, purchasing the land, and obtaining the necessary permits for a major complex is no easy task, especially in the densely populated Northeast United States.

The operational planning with respect to the type and general location of such a major facility must commence years in advance and be coordinated with and approved by **Comsat**'s partners in the Earth Station Ownership Consortium (ESOC). The site had to be on the East Coast of the United States so that the station could operate with satellites in orbit over the Atlantic Ocean. The existing two stations on the East Coast are located at Etam, West Virginia and Andover, Maine. The ideal location for the new site was, therefore, approximately midway between the two existing stations and in proximity to the international telecommunications switching facilities in White Plains, New York; New York City; Piscataway, New Jersey; and Pittsburgh, Pennsylvania. A further consideration in this particular case was that two of the East Coast stations had to be located sufficiently north to meet **Intelsat**'s system requirements that they be able to share the west spot beam of the Intelsat V Major Path 1 satellite with possible sites for a 14/11 GHz earth station in Canada.

Given the operational parameters, the most important aspect of site location is that the facility comply with the standards and regulations for Radio Frequency Interference, i.e., our facility must be so located as to not interfere

Post marks spot on the farm of Warren (Jim) and Ida Watkins where, once FCC approval is given, earth station will be built. Man on horse is James W. Robinson, neighbor of the Watkins and a retired employee of AT&T. During career with AT&T, Robinson was involved with operation of earth station in Andover, Maine.



with others and so that others do not interfere with us.

The Radio Frequency Interference Coordination procedures to prove the suitability of a site for the transmission and reception of signals to and from communications satellites in geostationary orbit are time-consuming and complicated. Comsat General Corporation maintains a computer data base which contains detailed technical parameters, geographical coordinates, path direction, antenna characteristics, transmit power, and other information on all microwave radio systems operating in the 4, 6, 11, and 14 GHz frequency bands. The computer is programmed to prepare "linker" charts which represent each microwave tower and the connecting lines which represent the signal paths between the systems. The site must be free from crisscross lines and their overshoot. We then perform a precipitation-scatter analysis by computer of each path which could cross close to the earth station antenna beam. This calculation derives its name from the effect raindrops in the clouds or in the air have on microwave signals.

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Above, *the Palachick General Store. Margaret (Peg) Palachick, right, her daughter Edith Saweikis, left. The Palachicks were early supporters of the project.*

Facing page; Top, *Peg Palachick, wearing Comsat hat, showing literature that she, her husband, Joseph, and daughter, Edith, have been handing out.* ***Bottom,*** *Warren (Jim) Watkins and his wife, Ida, whose 107-acre farm will be site of the Third East Coast Earth Station.*

Left, seven members of Cleveland Township community who played key roles in the earth station debate, as photographed in Cleveland Township Municipal Building, former one room schoolhouse. From left, James W. Robinson, Hal L. Snyder, Jr., Ronald Brown, Denny W. McKechney, David H. Adams, Richard H. Hornberger, and Robert B. Billig. Robinson was one of 14 witnesses speaking in favor of earth station before Zoning Hearing Board. Snyder is Assistant Project Manager for the earth station and a Comsat employee. Brown, McKechney and Billig are members of Zoning Hearing Board, and Adams and Hornberger are Township Supervisors. Adams and Hornberger and a third Supervisor, Carl Levan, made public statements in behalf of project.

*Top, Jim Watkins shows Hal Snyder scrapbook he has made up of press clippings on Third East Coast Earth Station project. Location: kitchen of Watkins house. **Right,** Watkins on porch of house on 107-acre farm.*

They, in effect, cause the microwave signals to scatter, i.e., divert from the normal straight-line transmission path and can cause some sites to be unacceptable.

Every entity and owner that operates a microwave link in the frequencies of interest must be informed of the proposal to establish a new station. Full details of the geographic location, technical parameters, proposed use, and other information about the proposed station must be provided to each and every operator of a microwave system that uses the same frequencies.

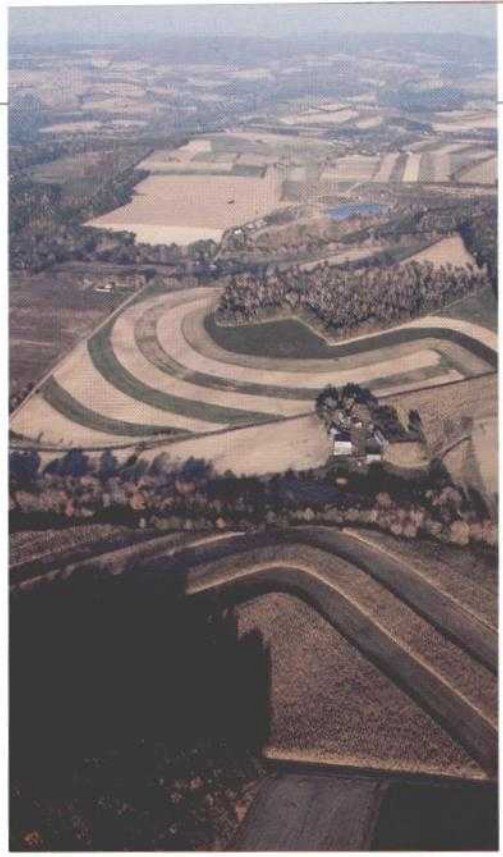
Only after this complicated and laborious procedure is completed and all potential conflicts resolved can this site be declared free of radio frequency interference and suitable for the earth station. Since this site had to be cleared for both the 14/11 and 6/4 GHz frequency bands, clearance was doubly difficult.

Once these preliminary efforts were completed and we had a general area in mind, we then had to determine whether a specific site was available for sale and whether the site met other important criteria such as:

1. Satellite visibility—The site must provide a clear path to the satellite unobstructed by trees, hills, buildings, and other structures.
2. It must be free from danger of flooding and other natural hazards.
3. It must be situated in proximity to at least two major terrestrial telecommunications routes so that the station is not entirely dependent on one entrance link.
4. The land must be free from mining rights, easements, oil leases right-of-ways, and other impediments, which might in any way prevent future development of the site for satellite communications.
5. The owner must have a good fee simple title to the premises, free and clear of all liens, encumbrances, reservations, restrictions, encroachments, and defects.
6. The site should have access to roads and power as well as an employee base, and must generally meet **Comsat**'s rigorous standards as a suitable workplace and facility location.

After examining over 200 potential locations, we located Mr. and Mrs. Warren Watkins' 107-acre farm in Cleveland Township, Columbia County. It met all of our criteria, and we were able to obtain an option to purchase. The farm is in the beautiful Roaring Creek Valley in Columbia County, Pennsylvania. The earth station complex will use approximately 10 acres of the farm and the remainder will be maintained in its present agricultural use. Mr. and Mrs. Watkins have a life estate on the property.

World Systems' Project Management and Engineering Division then sent a team to the site with measuring equipment to determine whether there



Left, aerial view of Watkins farm and surrounding countryside. Site of project is vee notched area surrounded by trees above center. Right, Fisherdale United Methodist Church and pavilion where Zoning Hearing Board meetings were held.

was any radio frequency interference that was not indicated in the computer reviews; the prior coordination notices were sent out to all microwave users who might be affected; and the process of resolving potential cases on interference was completed.

The next step in the process was to brief the Township Supervisors and the Planning Board of our intentions and to prepare the necessary materials for the Zoning Board so that the appropriate zoning could be obtained.

At this stage a major community relations activity was instituted by **Comsat**. Many people in the local community were not familiar with **Comsat** nor were they knowledgeable about satellite technology. Concerns were expressed about health hazards from microwave emissions; noise, traffic and whether the facility was compatible with the rural environment. **Comsat** made presentations on the facts and answered all questions at citizens' meetings at the local high school, meetings with the Grange, the Chamber of Commerce, and many other citizens' groups. By the time of the zoning hearing, the overwhelming majority of the citizenry was in favor of the installation and resolutions of support had been received from the County Commissioners, the School Board, the Grange, neighboring township supervisors, and many citizens' groups. The series of Zoning Hearing Board meetings were held at the Fisherdale United Methodist Church pavilion in Cleveland Township. A total of approximately 1,000 residents attended the meetings to hear **Comsat** present its case.

In setting forth its conclusions and order, the Zoning Hearing Board acknowledged that the proposed use of the land for a satellite earth station constitutes appropriate public use as that term is defined in the Cleveland Township Zoning Ordinance and that **Comsat** satisfied the conditions necessary to obtain a special exception as set forth in the Ordinance. The application was therefore granted upon the following conditions:

1. **Comsat** will comply with the pertinent regulations of the RA—Rural Agricultural District.
2. **Comsat** will construct or reimburse Cleveland Township for the reconstruction of any Township road damaged by its activities in putting its facilities into operation.

A significant finding of the Zoning Hearing Board was with respect to the possible environmental and health aspects of low-level microwave emissions.

The Board stated:
*"... While it did not have the burden to do so, **Comsat**, through expert testimony, which was uncontradicted, established that no harm will result from microwave as utilized in its proposed operation."*

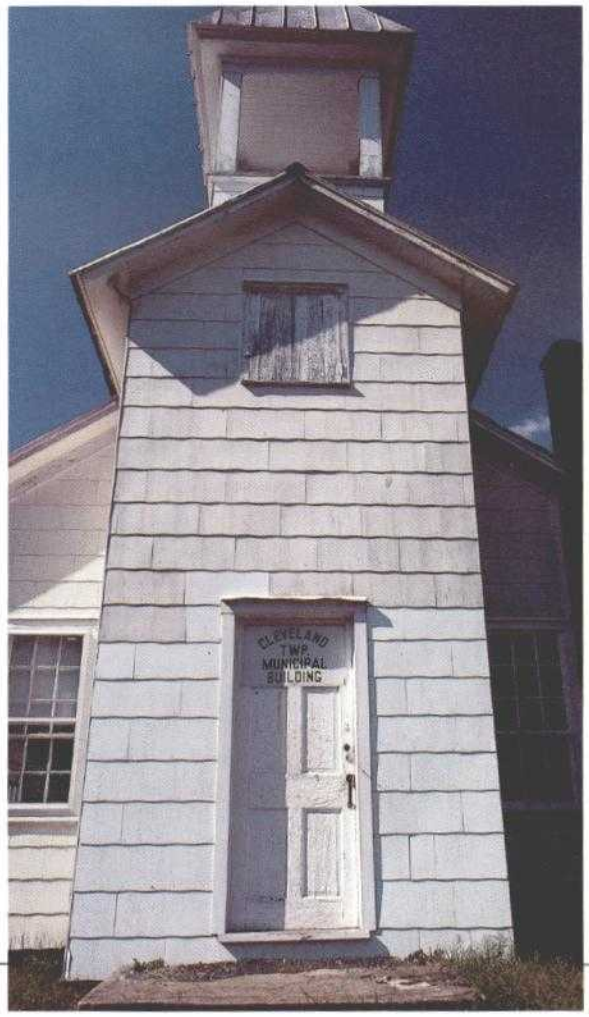
Comsat's World Systems Division has commenced the process of obtaining the Architectural and Engineering studies involved in the facility, and as soon as approval is received from the Federal Communications Commission, will actively move toward obtaining contractors to construct the station. Construction is expected to commence

by mid-1982 and continue until mid-1984, at which time the station as presently planned should be completely equipped.

The new earth station will be the largest earth station complex ever activated in the Intelsat System. Cleveland Township will join only four other areas in the continental United States with a similar facility. The space age will commence for the agriculture-based community which has manifested an open-hearted welcome to our presence. On our part, we will be a good neighbor as we have proved to be in the areas of our other earth stations. The earth station will emit no smoke or noise, will create no traffic problems, and will not present any danger to animals or people living nearby. We plan to purchase as many supplies and materials as possible from the area of the earth station. Our new station will increase local tax revenues while maintaining a clean, environmentally sound operation.

Our other earth stations have built reputations as solid community assets, and our earth station personnel, many of whom reside near the stations, are active in community affairs. **Comsat** is proud of its role as a responsible corporate citizen in the areas where we do business and where our employees work and live. We pay state and local taxes which amount to hundreds of thousands of dollars annually in the jurisdictions where we operate earth stations.

The new station in Pennsylvania is just another stage in the development of international satellite communications facilities which annually connect the United States with increasing numbers of countries and which now provide the United States with about 12,000 voice circuits and thousands of hours of television to and from overseas points. Of more significance is the anticipated growth of international satellite telecommunications traffic which **Comsat** and its ESOC partners must handle over the next decade, for traffic is expected to double in the next four years and double again by the end of the decade.



Exterior of Cleveland Township Municipal Building, a former one-room schoolhouse, where Zoning Hearing Board announced its decision. For 21 years, Jim Watkins taught in the building when it was still used as a school.

FM-4

CHRONICLE OF A SATELLITE

Communications payload of Intelsat V Flight Model 4 being tested in anechoic slant range at Ford Aerospace facility in Palo Alto, California.

FM-4
BIRTH OF A SATELLITE

This is the first in a series of articles following the history of a specific Intelsat V satellite—FM-4. In this article, Mr. Bruno discusses the fabrication and testing of FM-4 by Ford Aerospace & Communications Corporation in Palo Alto, California. In future issues of ***Comsat Magazine****, we will look at pre-launch preparation of FM-4 in Cape Canaveral, Florida, and launch of the spacecraft and the associated activities of the Comsat Launch Control Center in Washington, D.C. The Intelsat V series of satellites is being built for* ***Intelsat****, the international organization with 106 member nations in which* ***Comsat*** *is the U.S. representative.* ***Editor's Note.***

by ***Lou Bruno****, Deputy Intelsat V Program Director, Ford Aerospace & Communications Corporation*
Photography by ***William J. Megna***

Extensive planning and the diverse talents of many people are essential to the production of an Intelsat V spacecraft. This article will describe the fabrication and assembly of the fourth flight model in a series of 15 spacecraft.

Each Intelsat V can provide 12,000 duplex telephone voice circuits and two color television channels. This requires the coordination and assembly of over 54,000 electronic components, 40,000 machined parts, and 4,000 graphite-epoxy parts for each spacecraft. One of the earliest events in this assembly process is the "kitting" of piece parts for spacecraft subsystem assembly. Flight Model 4 (FM-4) began life in March 1980 with the initial release of kits at the Ford Aerospace & Communications Corporation facilities in Palo Alto, California.

The Intelsat V spacecraft is modular by design, with the main elements being the Antenna Module, the Communications Module, and the Support Subsystem Module. This type of construction facilitates assembly as each module can be worked independently and concurrently. For example, the Antenna Module is completely assembled and tested off line before it is mated to the mainbody. If there are schedule deviations or work-arounds during construction or testing of the module, work would still progress on the other modules. This modularity also accommodates the integration of subsystems and components from our five multinational team members and over 50 major subcontractors.

The Communications Module is the first spacecraft module in assembly and contains all elements of the communications subsystem such as the 43 travelling wave tubes, 15 receivers, 10 upconverters and other associated equipment. This assembly takes place in a Subsystem High Bay Facility maintained as a clean room environment to prevent contamination during assembly. The north and south communication panels and antenna deck comprise the Communications Module structure and are made of aluminum honeycomb. The sequential mounting of the communications equipment onto the individual panels and their subsequent integration form the module. The wiring harnesses for the Communications Module are fabricated by hand on full-size fixtures. There are 43 individual wiring harnesses that use more than 10,000 feet of wire on each spacecraft. The coaxial cables are formed using special mandrels, and are then custom fitted. An initial visual inspection is performed and x-rays are taken of each of the over 700 connections to verify that a secure link has been established. These connections must be x-rayed each time they are disconnected or reconnected.

The completed Communication Module then moves to the test station. Complete electrical and communications subsystems tests at both C- and K-bands are performed for approximately one month. This testing is computer controlled and is performed in a thermal enclosure that provides cold and hot cycles ranging from 0 C to 40 C. The test data is reviewed with **Comsat** and **Intelsat** resident staff prior to transporting the Communications Module to

Facing page, RF screen at top of antenna tower that isolates 4 GHz signal from telemetry, command and ranging signal. Above, "earth" view of antenna tower. Below, Comsat representatives witnessing mass properties determination of spacecraft.

the larger Spacecraft High-Bay Facility. Many such data reviews and analyses will occur before FM-4 is shipped to the launch site.

In parallel with the Communication Module, the Support Subsystem Module (SSM) integration is performed in the Spacecraft High-Bay Facility which contains the alignment dock, assembly floor, and the RF anechoic slant range. The SSM structure consists of a central cylinder that is the main structural load-bearing member of the spacecraft, the Attitude Control Subsystem (ACS) deck, and the east/west panels. Like the Communications Module, the SSM panels are aluminum honeycomb with prefabricated wiring harnesses used for interconnection of the equipment boxes. These east/west panels are easily removed and replaced to facilitate working on the inside of the module and for testing purposes.

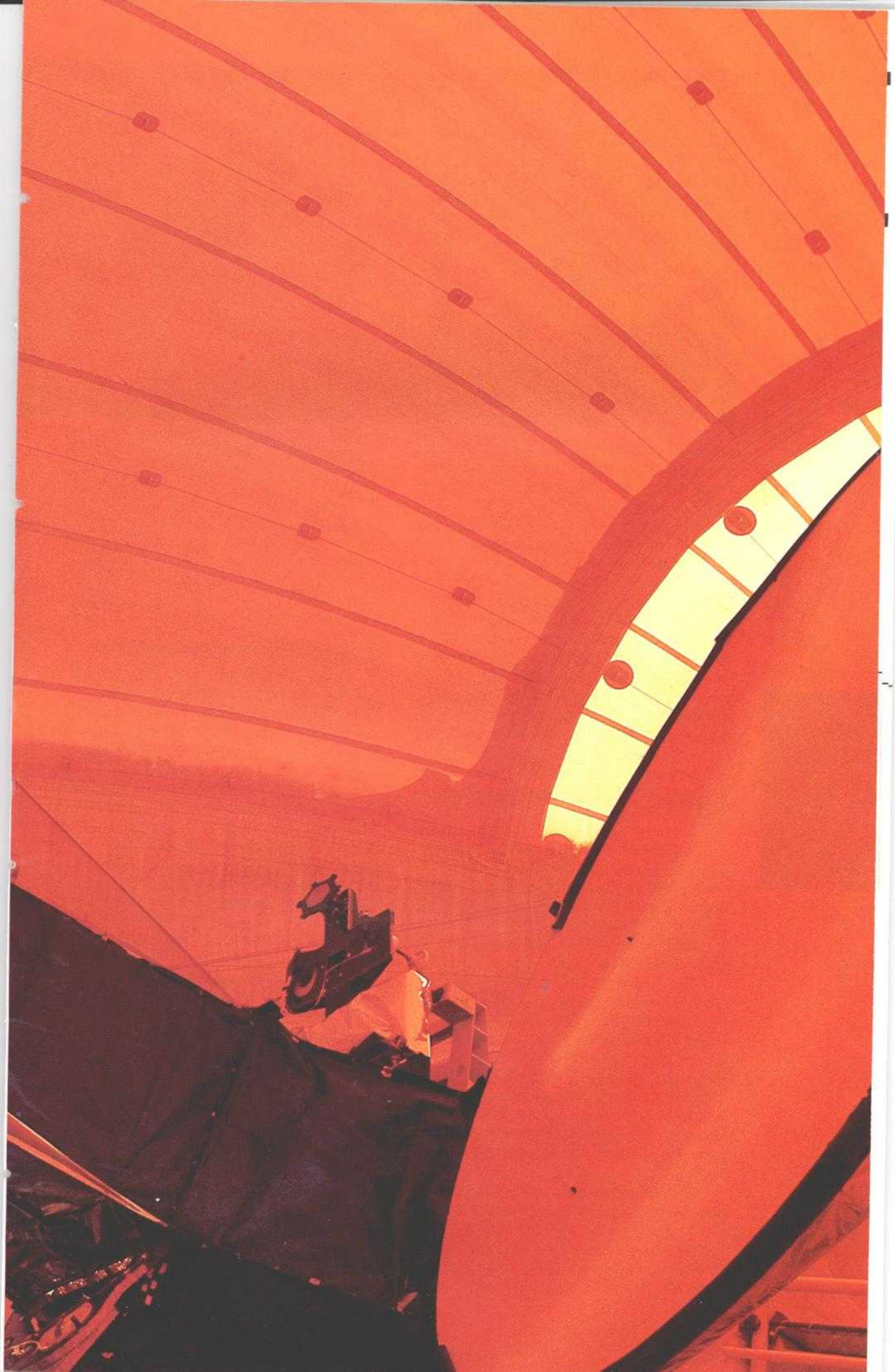
Mounted on the SSM are the hydrazine propulsion propellant tanks and lines, and the catalytic and electrothermal thrusters. After the propulsion system is installed, it is pressurized with a radioactive gas and a leak test is performed. The remaining equipment mounted on the SSM includes attitude determination control subsystem, momentum wheels, solar array drives, batteries, power control units, telemetry, and command electronics. The SSM is then ready for mating to the Communications Module to form the spacecraft mainbody.

While the mainbody module is being built, the antenna tower truss structure is fabricated in the Advanced Graphite-Epoxy Manufacturing Shop. Graphite-epoxy offers the unique properties of being lightweight while maintaining excellent thermal stability. The bare truss structure weighs 62 pounds and, when assembled as an Antenna Module, will support over 300 pounds of equipment. The truss structure will undergo a vibration test in the Environmental Test Facility to demonstrate its structural integrity. The structure is then transported to the Spacecraft High-Bay Facility where it is assembled into an Antenna Module.

The Antenna Module provides structural support and precise spatial positioning for the six communications antennas; five telemetry, command, and beacon antennas; and three infrared earth sensors. Working from the inside of the truss assembly, the Ford assembly crew installs the waveguides and coaxial cables. For mass reduction, a large number of these waveguides are fabricated using graphite-epoxy that has been copperplated on the inside. Following the installation of internal "plumbing," the C-band earth coverage and hemi-zone antennas are installed. The hemi-zone reflectors and their multiple feed arrays (88 feed horns per array) are all fabricated of graphite-epoxy. The two K-band reflectors are also graphite-epoxy and fed by single conical feed horns.

The tower module is moved to the alignment dock and the reflectors deployed to their orbital positions. Small optical cubes have been permanently

Antenna tower under test in Calaveras far field test range. **Below,** *deployed solar array undergoing physical inspection.*



Top, convex side of 4 gigahertz hemi/zone antenna. Gold colored material is multi-layer mylar insulation covering. ***Below,*** *completed spacecraft in thermal vacuum chamber simulating space conditions.*

attached to the tower truss structure and the antenna reflectors to provide alignment references. Optical theodolites and lasers are used to align the reflectors to the tower, and using the same references, the tower will later be aligned to the spacecraft mainbody.

The preliminary aligned Antenna Module is then transported to the Calaveras Antenna Range. This is a far field test range located in an RF signal-free area a short distance from our plant in Palo Alto. The hemi-zone feeds are empirically located, physically adjusted, and bonded into place for optimum RF response. The unique coverage patterns for each module are established and a permanent record is made. These patterns are composed of more than 500,000 individual data points and require almost a week of computer time to correlate. When the module is returned from the Calaveras Test Range, it is rechecked on the alignment dock, and the flight thermal blankets are installed. The completed Antenna Module is now ready for integration with the two modules that comprise the main body.

The final assembly of the three modules into a spacecraft takes place in the Spacecraft High Bay Facility. After the three modules are integrated, the solar arrays and the dummy inert apogee kick motor are installed. Flight Model 4 is now a complete spacecraft standing over 21 feet high and weighing more than 1,800 pounds. After a reference performance test, it is ready for spacecraft dynamics testing.

These tests subject the spacecraft to acceptance test levels of simulated launch and space environment. They are performance/workmanship tests and consist of sine vibration, acoustic, and thermal vacuum.

Thermal vacuum testing is performed in the 39-foot Space Simulation Chamber which is evacuated to 1/10,000,000 of atmospheric pressure. Banks of infrared heat lamps inside the chamber simulate radiated solar energy, and liquid nitrogen pumped through tubing maintains the chamber walls at —196 C. The spacecraft is electrically powered and "flown" in simulated orbital conditions for 30 days allowing us to monitor spacecraft response.

Upon completion of dynamic testing, FM-4 is positioned in the slant range in its orbital configuration and powered in various primary, redundant, and cross-strapped communications modes. This is computer sequenced, and well over 250,000 digital data points are obtained to assure final spacecraft performance. After the slant range testing, FM-4 is placed in its shipping container and transported by aircraft to the Cape Canaveral launch site.

The high bays are not empty though. The Antenna Module for FM-5 is ready for spacecraft integration, assembly is beginning on FM-6, kitting is in progress for FM-9, and this process will be repeated through FM-15. These 15 spacecraft will include the introduction of maritime communications service on FM-5 through 9, and increased C- and K-band capacity on FM-10 through 15.

A key ingredient to producing these spacecraft is the direct contribution of staff from **Comsat** and **Intelsat**, interacting with the Ford Aerospace team. Although the Intelsat V program is the product of sophisticated technologies, extensive planning, and multinational cooperation, it is the dedication of people who make it work.

INDEX TO SUBJECTS IN THE FIRST SIX ISSUES OF COMSAT MAGAZINE

Readers engaged in legitimate research projects who do not have a file of back issues of *Comsat Magazine* should write specifying the subject or subjects from the following Index they are interested in. We will respond by sending photocopies of appropriate passages as referenced in the Index. Address correspondence to Patricia A. King, Editorial Assistant, Comsat Magazine, Communications Satellite Corporation, 950 L'Enfant Plaza S.W., Washington, D.C. 20024. Please note that to keep page references from becoming ponderous, we refer only to the first mention of a subject in an article. Readers should read to the end of an article for subsequent references.
Editor's Note,

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continued from page 4

106-member-nation International Telecommunications Satellite Organization. The Moree earth station is operated by OTC(A). From Moree, the television signal will go by land lines to TCN 9, a television broadcaster in Sydney, and to other stations of the Nine Network.

Inmarsat Council looks at space segment

The Ninth Session of the Inmarsat Council took place October 14-21, 1981, and was hosted by the Signatory of Singapore, the Telecommunications Authority of Singapore.

The meeting was conducted by the newly elected Chairman, Mr. L. F. T. Perrone of Brazil, with Mr. Edward J. Martin of the United States as Vice Chairman. Mr. Martin is Vice President, Maritime Services, Comsat World Systems Division.

Council Highlights

Inmarsat's first space segment system will become operational on February 1, 1982, through use of the commercial capacity in the three Marisat satellites in the Atlantic, Indian and Pacific Ocean regions. Current plans anticipate that the Marecs A and B satellites, to be launched by the European Space Agency, will be available for service in March and July 1982, respectively. The three Intelsat V satellites with maritime communications subsystems (MCS) are expected to be available in August and December 1982, and April 1983. Based on these assumptions, the Council decided that:

- the transfer in the Atlantic Ocean Region would be to a Marecs or Intelsat MCS satellite, whichever becomes available first;
- the transfer in the Indian Ocean Region would be to an Intelsat MCS satellite as soon as one becomes available;
- the transfer to Marecs B in the Pacific Ocean Region would be deferred in order to keep Marecs B available for relocation to another region, if required;
- the Director General will have certain latitude to transfer traffic to an alternative satellite in the interests of restoring satisfactory communications or to decrease risk to satellite performance or lifetime and to relocate a Marecs satellite, if required, to restore service to another region.

Concentrated effort has already started in developing alternatives for **Inmarsat**'s second generation space segment facilities, which will be required no later than the end of 1988.

With respect to financial matters, the Council approved a 1982 budget of $32,616,000. The Council also decided to increase the capital ceiling of the organization from $200 million to $250 million.

The Council approved a report of the Council to the Second Assembly Session, which was held in London November 23-25, 1981, on the activities of the organization during the past two years. A separate Council report to the Assembly was approved reflecting the decision by the Council that the Assembly should urge all Inmarsat parties to take any necessary steps to make possible full use of ship earth stations within harbor limits and other waters under national jurisdiction by modifying existing domestic laws and regulations or through bilateral or multilateral agreements.

Finding permanent accommodations for the organization has been a major concern of **Inmarsat** since its inception. Present space at Market Towers in London will be outgrown in late 1982. A number of possibilities are now being considered, and the Council is expected to decide at its next session on a Headquarters location adequate for at least several years.

R&D Budget Approved

The Council approved R&D expenditures of $1.5 million in 1982. A general policy to govern Inmarsat R&D activity was adopted as well. The program will be designed to improve the efficiency of

maritime satellite communications; reduce the cost of equipment used in the overall system; allow the introduction of new services; improve safety and distress capabilities; and widen the coverage area of the Inmarsat system. A long-term R&D program will be proposed, and it will be reviewed annually.

In the interest of encouraging efforts to develop new mobile services it was also decided, in the context of the R&D program, that space segment capacity could be made available for general mobile experiments and pre-operational trials on a preemptible basis.

Pursuant to the Inmarsat Convention, the Council must give specific approval to the use of the Inmarsat space segment by ship earth stations located on structures in the marine environment other than ships. The Council approved requests by Japan and the Federal Republic of Germany for the continued operation of experimental stations now operating in the Antarctic with the Marisat system. Such approvals are required by the Convention to be conditioned on use not significantly affecting the provision of service to ships.

The next session of the Council will meet in London, February 10-17, 1982, and the Eleventh Session will meet in Stavanger, Norway, at the invitation of the Norwegian PTT, July 7-14, 1982.

Position of Vice President, Corporate Development, filled

Bruce D. Smith has assumed the position of Vice President, Corporate Development, of **Comsat**. Previously, he was Vice President, Planning and New Ventures, for Comsat General Corporation. In his new position, Mr. Smith is responsible for and directs corporate strategic planning and **Comsat**'s internal resource allocation process. He also serves as the senior Comsat officer responsible for acquisition, merger and joint venture activities.

In his previous position, Mr. Smith led **Comsat General**'s successful efforts to negotiate an acquisition by merger agreement between **Comsat General** and Amplica, Inc., a California-based manufacturer of microwave amplifiers.

Before joining **Comsat General**, Mr. Smith had been Chief Executive Officer of Allied Water Corporation, a manufacturing firm located in San Francisco, California. From 1975 to 1978, he served as General Manager at G.D. Searle & Company's Ultra Equipment Division, where he was responsible for the provision of high-technology medical equipment and services worldwide.

Comsat will participate in World's Fair in Knoxville

Comsat plans to participate in the 1982 World's Fair, in Knoxville, Tennessee scheduled May-October. The Comsat exhibit, to be located in the Fair's "Lifestyle and Technology" Building, will demonstrate the company's unique contributions to the world of tomorrow.

Highlights of the planned Comsat exhibit include:

- an exhibition of the global satellite communications services provided by **Comsat** and the wide range of new technologies employed by the corporation;
- a display of modern satellite teleconferencing;
- A display of the newest generation in the technology of home television viewing: Direct Satellite-to-Home Subscription Television.
- **Comsat**'s revolutionary multibeam

N O T E S

satellite antenna, called Torus.

The Comsat exhibit will cover 1,500 square feet with an antenna located outdoors.

Commenting on the company's decision to participate in the World's Fair, Comsat President and Chief Executive Officer Dr. Joseph V. Charyk noted, "We at Comsat are excited about the Knoxville International Energy Exposition and our participation in it. Through the application of advanced technologies to communications and other needs, we have contributed, and will continue to contribute, greatly to mankind's need to increase productivity and thus save energy. We are proud to be a part of the Fair's theme: Energy Turns the World."

The Knoxville International Energy Exposition is the first World's Fair to take place in the Southeastern United States, and is expected to draw eleven million visitors from around the world.

Officer of ERT presenting briefings on Clean Air Act

Dr. James R. Mahoney, Senior Vice President of ERT, has been briefing businessmen in key cities on the status and probable future of the Clean Air Act, particularly in light of the findings of the ERT study for The Business Roundtable, an association of chief executive officers of 200 of the nation's major companies. The ERT study, of some 150 industrial companies, was completed in the summer of 1981. The study found that regulatory practices stemming from the Clean Air Act were unnecessarily complex, costly, and inflexible. These practices impeded not only industrial planning and development but also the achievement of improvements in air quality.

As Congress deliberates over revisions to the Clean Air Act, it is likely that such findings as those of the ERT Business Roundtable study will affect the language and intent of the new regulations to reflect the dual legislative objectives of promoting industrial growth and improving air quality.

Dr. Mahoney has reviewed The Business Roundtable Study findings and recommendations and discussed prospects for change in the Clean Air Act to audiences of business persons, civic leaders, and regulatory agency staff members in Chicago, Los Angeles, Denver, St. Louis, and Houston. He may continue these briefings for interested groups into 1982.

Head of Information Systems Group named by ERT

C. Patrick Bartosh, manager of ERT's Denver office, has been named Vice President and General Manager of Regional Operations for ERT's Information Systems Group. Mr. Bartosh will direct the company's nationwide environmental monitoring activities.

The Information Systems Group has four regional divisions which set up environmental monitoring networks, collect data needed by industrial and governmental clients and analyze and manage environmental information.

AT PRESS TIME

STC seeks to offer satellite pay-TV service in late 1983 as forerunner of satellite-to-home television

Satellite Television Corporation (STC) plans to introduce a two-channel pay-television service delivered via satellite to the northeastern United States in late 1983.

STC President Irving Goldstein said, "The 1983 service is designed for multiple family dwellings. It is a forerunner to our direct-to-individual-home service targeted for introduction in late 1985 or early 1986."

The forerunner service will be sold principally to residents of multiple family dwellings, including apartment and condominium buildings, hotels, motels, and mobile home parks. STC's subscribers will share a satellite receiving antenna about 5 to 6 feet in diameter, and the TV signal will be distributed to individual customers through a master antenna TV system.

"Satellite pay-TV service will offer diversity and new video options to consumers who do not have access to cable TV," Goldstein said. "Today, numerous American TV viewers still do not have access to supplemental pay television services."

Beginning in late 1983, STC will provide two channels of premium programming without advertising. The first channel will operate 24 hours a day offering major motion pictures. The second channel will offer 15 hours of daily programs including film classics, sports, variety and family entertainment, children's programs, and special interest programs such as women's, minority-oriented and performing arts shows.

The cost to individual subscribers who reside in multiple family dwellings receiving STC's two-channel pay-TV service will total approximately $22 to $25 per month (1981 dollars) including the rental cost of the equipment. Individual subscribers also will pay a modest installation charge and a fully refundable deposit.

A number of satellites are expected to be launched and available by 1983 which could be used by STC to offer the two-channel service announced today. STC is reviewing the alternatives to determine which will offer the power and performance needed to permit STC to provide satellite service to 5- to 6-foot receiving dishes. Also, the coverage area of each satellite varies. However, the alternatives being reviewed would cover at least the northeastern states.

STC has initiated talks with potential suppliers of the receiving equipment needed in 1983, including the receiving antennas and decoders to unscramble the TV signals.

Federal Communications Commission (FCC) approval would be required in order to implement the service. Appropriate FCC applications will be filed in the near future.

Introduction of the new service is contingent upon approval of STC's Direct Broadcast Satellite (DBS) application submitted to the FCC in December 1980. The DBS application is for a three-channel service to be delivered via satellite directly to individual subscribers beginning in the eastern time zone. This service ultimately will be available nationwide. Subscribers will receive the DBS service with even smaller, less expensive antennas (from 2 to 3 feet in diameter) at individual homes.

STC's future DBS service, however, requires use of special, higher powered satellites which STC will build after receiving the necessary approval from the FCC. Construction of new satellites to cover the first DBS service area (roughly equivalent to the eastern time zone) requires three to three and a half years.

STC's initial application for construction approval currently is pending at the FCC. Assuming the FCC approves the application in the coming months, STC's three-channel DBS service could be introduced in late 1985 or early 1986.

When STC's three-channel DBS service is introduced, subscribers to the multiple family dwelling service will be switched to the expanded three-channel service.

STC is a wholly owned subsidiary of Comsat. The subsidiary was formed in 1980 to pursue development of satellite pay-TV through Direct Broadcast Satellites.

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