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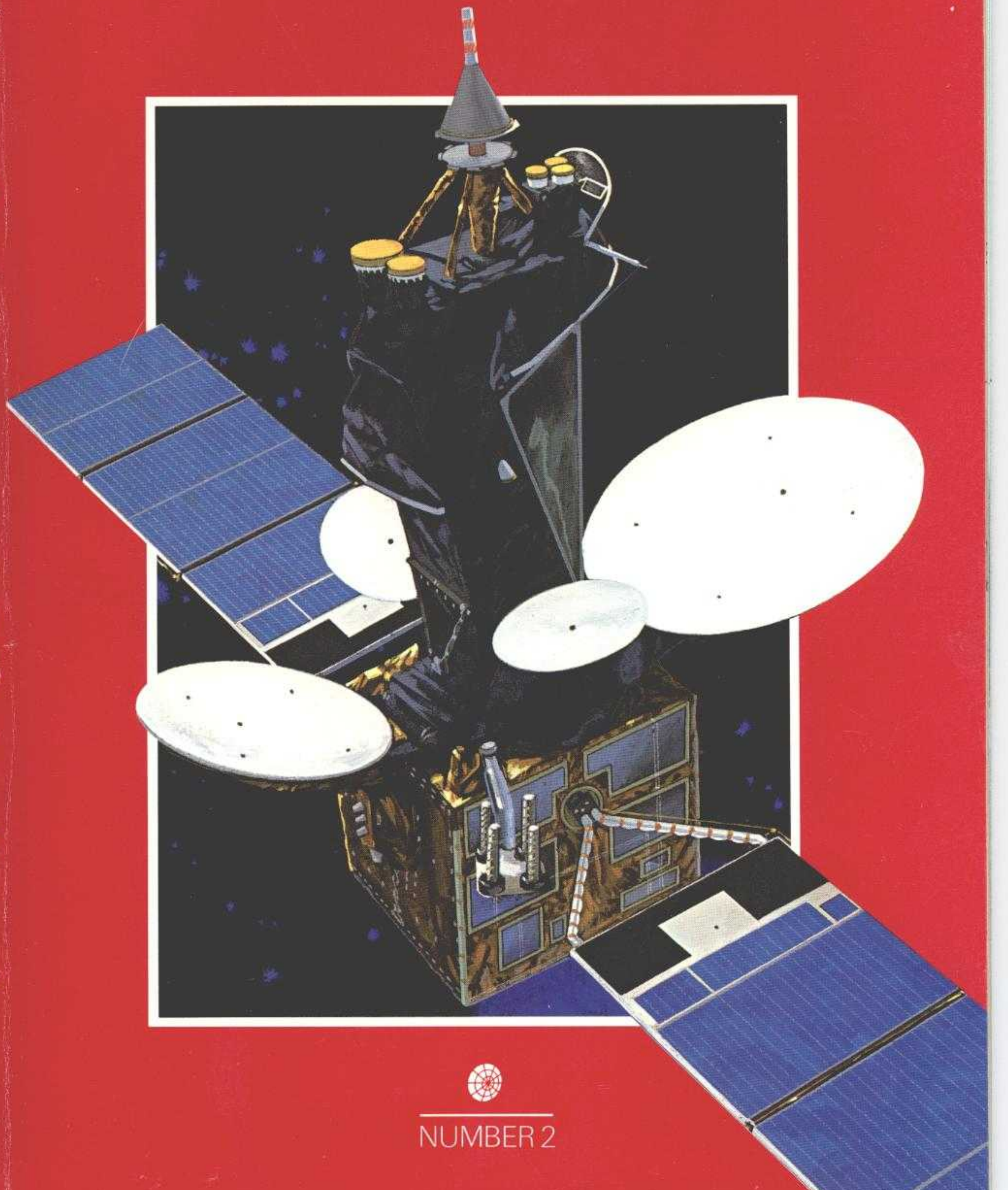


NUMBER 2

Television from satellite to home

by Timothy G. Brosnahan

By the mid-1980s, there should be a new star in the sky, an advanced satellite beaming three channels of television programming, without advertising, direct to the homes of individual subscribers.

In December 1980, Satellite Television Corporation (**STC**), a new member of **Comsat**'s corporate family, released the details of its proposed nationwide satellite subscription television service. **STC** has requested Federal Communications Commission approval to establish the first phase of its direct broadcast satellite system to serve an area corresponding roughly to the Eastern time zone of the United States. (Richard E. Wiley with the law firm of Kirland & Ellis and former Chairman, FCC, looks at the STC proposal starting on page 29.)

Three to four years after getting a go-ahead from the FCC, **STC** will begin broadcasting three channels of entertainment, educational, cultural and public affairs programming direct to inexpensive 2½-foot "dish" antennas at subscribers' homes. The TV programs, scrambled to prevent unauthorized reception, will be fed from the receiving antenna, through a small descrambler/channel selector, to the subscriber's standard TV set.

The STC service will significantly expand the television entertainment options available to millions of Americans and will offer major benefits to the public.

- It will provide a new, economical source of diverse and specialized video programming to consumers, particularly those who will not have access to cable or over-the-air pay television.
- It will enhance competition in the subscription television and program distribution markets.
- It will stimulate additional program production by traditional and new sources.
- It will support thousands of new jobs.
- It will advance the state of satellite communications technology and help maintain U.S. leadership in this vital field.

The System

The first phase of **STC**'s service will require two satellites—one operating and one an in-orbit spare—located 22,000 miles over the equator. Signals would be broadcast in the 12 GHz frequency band allocated internationally for broadcasting satellites.

Three more operating satellites later would be needed to serve the other continental time zones and the most populated parts of Alaska and Hawaii.

A central STC broadcast center for satellite control and program origination will be established in the Las Vegas area. Additional ground support facilities will be located at Santa Paula, California, and Washington, D.C.

The direct broadcasting satellites will have a number of features that distinguish them from current communications satellites. Most important, they will have only three operating transponders with high powered traveling wave tube amplifiers operating with a minimum radio frequency power of 185 watts each. Domestic satellites in use today generally have more transponders but have much smaller tubes operating at five to ten watts of power. Basically, it is the high power of **STC**'s satellites that allows consumers to use very small and inexpensive receiving antennas.

In addition, the satellites will have the technical capability of providing optional service features to consumers, including stereo sound and simultaneous second language audio. Other service features would include teletext and closed captioning for the hearing-impaired. The satellites will be used for experiments with high definition TV pictures. It is hoped these experiments will help to develop uniform technical standards for high definition television, standards that will be necessary for future use of large-screen TV receivers.

Programming: The Key

With the growth of cable and over-the-air pay-TV, numerous public opinion surveys and research commissioned by

by STC

STC show there is a significant and growing public demand for supplemental video services. Satellite-to-home television will provide a major new addition to the video options available to consumers.

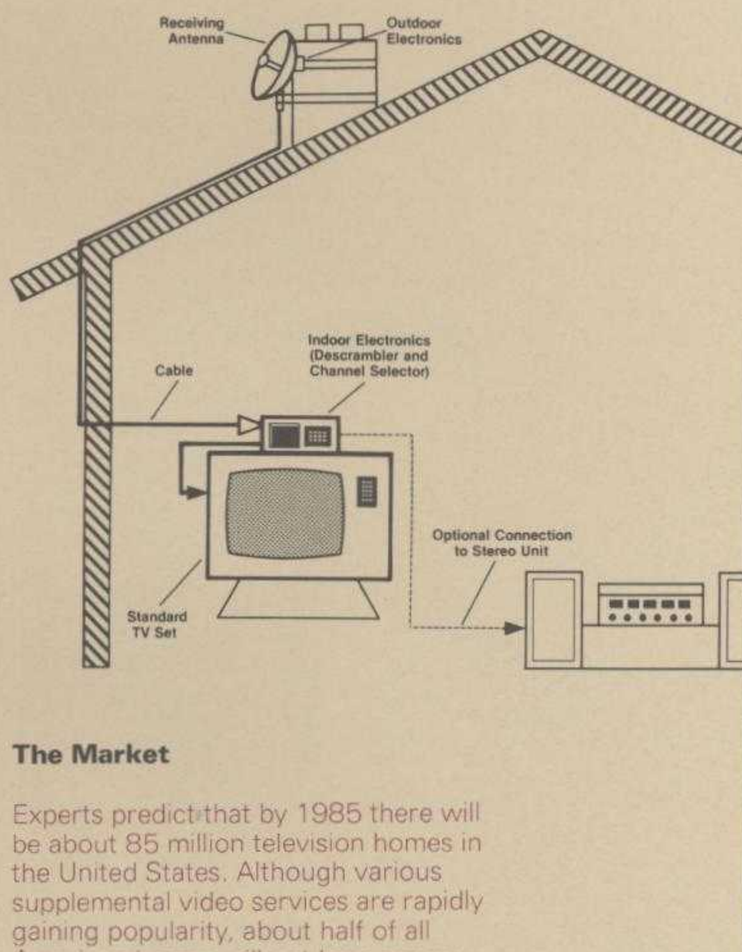
The STC service will provide three channels of varied TV fare. The "Superstar" Channel will operate 24 hours a day with a mix of major motion pictures, popular concerts, theatre specials, and family entertainment. The "Spectrum" Channel and "Viewer's Choice" Channel will each have about 15 hours of programming a day, offering a combination of children's programs, film classics, public affairs, cultural shows, sports, adult education, experimental theatre and a variety of lectures.

The three-channel capacity of the system will enable STC to "counter-program" so that different types of programming would appear simultaneously on each of the three channels. In this way, the service will appeal to a variety of audiences at the same time. For example, on a given evening, "Superstar" might offer a movie at the same time as a ballet appears on "Spectrum" and a hockey game on "Viewers Choice."

STC also will have the ability to offer programs aimed at relatively narrow audiences. The service can reach viewers who may be scattered throughout a time zone or across the country who have special interests and can accumulate them as a group of subscribers to support special programming. This ability to serve narrower audience interests by "narrowcasting" enables STC to offer a greater breadth and variety of programming than is currently available.

In addition, since STC will offer a limited number of programs on a special subscription basis (per program or per series), subscribers will be able to "vote" for the kind of occasional programming they want.

STC plans to purchase programming and, to a limited extent, will commission additional programming from a wide variety of existing producers. It will seek out new independent production sources particularly for the more specialized types of programming, including programs aimed at the needs and interests of minority groups. As a major new participant in the home video services industry, STC will be an important new outlet for program distribution and should help stimulate new program production. As the system completes its nationwide expansion, STC will be able to devote considerable resources to the development of new programming.



The Market

Experts predict that by 1985 there will be about 85 million television homes in the United States. Although various supplemental video services are rapidly gaining popularity, about half of all American homes will not have access to cable by 1985. Particularly in densely populated urban centers and in less-populated and rural areas, the installation of cable may simply be too expensive. It is these areas, particularly where broadcast TV reception is less than optimal, that offer the major market opportunities for satellite subscription television service.

Continued next page

STC is committed to offering its service at costs competitive with other pay-TV services. In 1980 dollars, the basic three channel programming service would cost subscribers $14-18 per month. Customers could lease or buy their home equipment, either from STC or from independent suppliers. The three-channel service and equipment leased from STC would cost a total of about $25 per month. In addition, there would be a one-time charge of $100 for purchase and installation of the dish antenna.

It is expected that numerous manufacturers, installers and maintenance entities will compete in this home equipment field to market the service. The various components will be produced by a number of manufacturers. STC plans to establish a network of local authorized dealers to sell or lease, install and maintain the home equipment. It is also expected that independent companies will enter the field.

John A. Johnson, Chairman, Satellite Television Corporation (STC) describes three-channel satellite-to-home subscription television service at press conference.

Technological and Economic Impact

This new supplemental video service will have significant technological and economic benefits. Development of this service will help maintain U.S. leadership in satellite communications. Japan and Canada have already experimented with similar systems. Several European countries are developing plans for satellite TV. If authorized quickly, however, STC's system could help maintain U.S. technological preeminence in this important and rapidly growing field.

Development of direct broadcasting service will promote U.S. economic activity in a high technology field which is important to the nation's future. Significantly, the U.S. Bureau of Labor Statistics estimates that a nationwide STC system would directly or indirectly support 23,000 jobs at the peak of activity and 15,500 jobs over the long term. The areas of greatest job impact would be in program and equipment production, installation and maintenance of home receiving equipment and retail merchandising.

To ensure that minority groups share in the economic benefits of the new service, STC plans to establish a Minority Enterprise Small Business Investment Company (MESBIC) following FCC approval of its application. The MESBIC would be capitalized at $1 million. This funding, together with matching funds from the Small Business Administration and private loans to individual minority firms, could make well over $4 million available for investment in minority businesses, particularly in the areas of merchandising, home equipment installation and maintenance and program production.

With its public, technical and economic benefits, STC's new service should be a bright star indeed. It will help satisfy the strong consumer demand for home video options. It will stimulate new program production, support new jobs and advance the state of satellite technology. For Comsat, it serves as a significant step forward in bringing the benefits of satellite communications to the American public.

First Intelsat V launched

by Dr. John L. McLucas, President, Comsat World Systems Division

The evening of December 6 was a beautifully clear one in Cape Canaveral, Florida, and those of us privileged to be present for the launch of the first Intelsat V satellite were given a real treat indeed. For the view from the reviewing stand was unobstructed by the haze that often drifts in off the ocean in that part of Florida. What we saw, as the photograph on the following page in part depicts, was the rocket rise from the pad on a plume of fire and arc smoothly into its launch trajectory as it rose with roaring power into the dark night sky. We were able to see that plume of fire, though it grew smaller and smaller, well over a minute after the rocket had lifted from the pad.

The clearness of the evening not only revealed to us a perfect launch but was a portent of what was to come. For the spacecraft performed almost flawlessly as it passed through initial and transfer orbits into geosynchronous orbit and then deployed all of its antenna and solar arrays. (One of the antennas failed to deploy immediately after it was ordered to do so from the ground, but eventually it did achieve its full operational position.)

We at Comsat World Systems Division believe that this most auspicious start for a new generation of satellites—the most powerful commercial communications satellite yet put into orbit—is cause for unflagging confidence in the future of communications via satellite, in the 105 nation International Telecommunications Satellite Organization (Intelsat) and in Comsat's services to and through the Intelsat system. As my colleagues in Comsat World Systems Division—Joel R. Alper, Robert W. Kinzie and Louis Pollack—point out in the following articles, the Intelsat system, both its in-orbit segment and the segment on the ground, has made enormous strides in the relatively brief history of Comsat and thus in the relatively brief history of the commercial exploitation of space for communication services. These strides, however, will be eclipsed in magnitude by what is expected in the Intelsat V era and beyond, they point out.

Indeed, the new generation of satellites makes it possible for us to offer services that earlier systems have only promised. The bulk of Intelsat revenues to date has been from international telephone traffic. With the advent of the Intelsat V, we are moving toward that time when digitized data of all forms will represent a very large amount of the system's message traffic. Admittedly, it will be a long time before the balance swings from analog voice traffic, but now we are getting the pieces together for the system of the future.

For the near term, we can predict the substantial growth in the volume of voice, data, television and news copy transmitted by the system and at the same time an acceleration in its use to provide domestic communication services for countries seeking a relatively quick and inexpensive way of providing modern telecommunication services.

Finally, it takes no seer to predict that Comsat will continue to be the single leading organization in the world when it comes to the provision of all the services necessary to design, build and operate a satellite-oriented communications system.

Log of a Successful Launch

	Scheduled	Occurred	
6 December 1980	**T-640 min.**	(7:05 a.m. EST until 13:10 p.m. EST)	• Launch vehicle readiness tasks and preparations.
	T-2 sec.		• Main engine ignited.
	T-0	(18:31:00 EST) (23:31:00 GMT)	• LIFT-OFF: (occurred 6 min. later than scheduled) At lift-off the Atlas delivers a thrust of 195,000 Kg., imparting an acceleration of 1.2 g.
	T+2 sec. to T+15 sec.		• Roll maneuvers performed.
	T+15 sec.		• Start pitch.
	T+139.6 sec.		• Booster engine cut off (BECO) after an acceleration of 5.7 g. is attained.
	T+142.7 sec.		• Booster section jettisoned.
	T+184.6 sec.		• Insulation panels between first and second stage jettisoned.
	T+212.6 sec.		• Nose fairing jettisoned.
	T+222 sec.		• Start boost pumps.
	T+254.9 sec.		• Sustainer engine cut off (SECO).
	T+256.8 sec.		• Atlas/Centaur separation—Atlas re-entry into atmosphere.
	T+263.4 sec.		• Centaur main engine start (MES-1).
	T+575.2 sec.		• Main engine cut off (MECO 1).
	T+1422.6 sec.		• Centaur engine re-start (MES-2) occurs at the first equatorial crossing.
	T+1516.4 sec.		• Main engine cut off (MECO 2).
	T+1575 sec.	(18:57:15 EST) (23:57:15 GMT)	• Zamengoe acquisition.
	T+1651.4 sec.		• Spacecraft separation. V is now in transfer orbit: apogee alt. 35,800 km., perigee alt. 167 km., orbit inclination angle 23.76 degrees.
	T+1831.4 sec.		• Start Centaur blowdown to change its orbit from that of spacecraft. Carnarvon acquisition. (First pass wasn't seen.)
7 December	**T+5:40 hrs.**	(00:11:00 EST) (05:11:00 GMT)	• First apogee (94.5 deg. East longitude).
	T+16:10 hrs.		• Second apogee (296.5 deg. East longitude). Touch-up, reorientation performed prior to second apogee.
	T+26.42 hrs.		• Third apogee (138 deg. East longitude). Touch-up, reorientation performed prior to apogee motor firing (A).
8 December	**T+37:00 hrs.**	(A+0:00 hrs.) (7:31:00 EST) (12:31:00 GMT)	• Apogee motor firing (A) occurs at 4th apogee at a longitude of 342 degrees East. The apogee motor imparts the extra velocity needed to attain the geosynchronous orbit (at the altitude 35,401 Km.) and the orbit plane change of 23.75 deg. Duration of motor firing is 62 sec.
	A+1.10 hrs.		• Despin of 2 RPM (1038 Pulses)
	A+1 to 20 hrs.		• Ground stations determine the drift orbit, attitudes and develop drift orbit corrective strategy.
9 December	**A+23:00 hrs.**	(P+0:00) (7:59:00 EST)	• Post A velocity correction (P). Thrusters 1A and 1B manually fired. (Firing time 70.11 sec.)
		(08:18:51 EST) (13:18:51 GMT)	• Dawn
	P+11:00 hrs.	(18:58:00 EST) (23:58:00 GMT)	• Despin (D) spacecraft to 20 RPM followed by rate damping to 0.5/sec. in all axes.
	D+0:35 hrs.	(19:27:00 EST) (00:27:00 GMT)	• Sun acquisition
	D+1:40 hrs.	(20:18:00 EST) (01:18:00 GMT)	• Solar array deployment: full array power is available.
	D+2:35 hrs.	(20:53:00 EST) (01:53:00 GMT)	• Communication Group #2 turned on.
10 December	**D+3:35 hrs.**	(21:59:00 EST)	• Thermal reconfiguration (propellent heater on)
		(01:05:00 EST) (06:05:00 GMT)	• Earth acquisition completed.
		(01:26:00 EST) (00:26:00 GMT)	• Momentum wheel is spun up.
		(07:20:00 GMT)	• S/C is in normal operation (3 axis).
		(14:30:00 EST) (19:30:00 GMT)	• Communication antenna deployment.

How launch of first Intelsat V looked to people in stands at NASA launch complex in Cape Canaveral, Florida.

INTELSAT V

NEW SATELLITES, NEW CHALLENGES

by J.R. Alper
Vice President, Operations
International Communications Services

The December 6, 1980, launch of the first of nine high capacity Intelsat V satellites signalled the beginning of a new era for **Intelsat** and the culmination of almost a decade of effort by **Comsat** and its many foreign partners in **Intelsat**. That launch placed into geostationary orbit over the Atlantic Ocean the first component in a network of Intelsat Vs which will provide a major portion of the world's telecommunication links for the 1980s. In addition to providing capacity to meet continually growing demand for international voice, data and television services, the Intelsat Vs have a multi-service capability which will permit **Intelsat** to continue provision of domestic services, and to initiate provision of maritime communications services. The Intelsat V will introduce 14/11 GHz operation into the system, and will employ highly advanced frequency reuse techniques in order to utilize limited bandwidth resources most efficiently. These two elements in turn have required extensive coordination between **Intelsat** and its 105 Signatories to modify the Signatory owned and operated earth segment to match the capabilities of these new satellites. Introduction of this new satellite thus represents the result of many years of planning.

Service Requirements

In 1972, shortly after the first Intelsat IVs had begun operation, planning began for the Intelsat V satellites. **Comsat** as U.S. Signatory has, through the **Intelsat** Board of Governors and Planning and Technical advisory bodies, participated in the development of alternative system designs, management of contract development and review of Intelsat V construction. What was in 1972 only a vague concept has been refined, developed and finally launched.

In the early stages of planning for the Intelsat V, proponents of two separate points of view discussed their differing positions. There were those who wanted only a modest, arithmetical growth in capacity, and those who preferred to take the extra time to develop a satellite which could handle accelerating growth. **Comsat** played a major role in the latter group and, as development of the specification for the Intelsat V progressed, it became apparent that a truly high capacity Intelsat V would be needed, as the predecessor Intelsat IV-A satellites would, by the early 1980s, have insufficient capacity to cope with the traffic load on either the Atlantic or Indian Ocean Primary satellites. The Primary satellite interconnects all users within each ocean region; the Atlantic region also has two major path satellites which are accessed by additional antennas provided by major users in order to divide large traffic streams among diverse paths.

The Atlantic area has traditionally had the heaviest traffic requirements. The Atlantic Primary satellite has been the pacing factor for expansion of the global system, with Indian Region demand also becoming critical. **Intelsat** endeavors to design its satellites to meet traffic requirements, projected by its users, for the full seven year design-life of the satellites. These traffic forecasts are adjusted at least annually. Thus, one challenge in the Intelsat V system planning which was undertaken beginning in the early 1970s was to develop plans which would accommodate such changes into the mid-1980s. In 1972, for example, traffic in the Atlantic Region totalled only 2,380 circuits; between 1972 and 1975, it virtually doubled and it is projected to reach over 33,000 circuits in 1985. Thus, it was necessary to procure a satellite that could accommodate, as the Atlantic Primary, a substantial number of circuits, and provide sufficient capacity to match still further expected increases in demand. The contract signed with Ford Aerospace and Communications Corp. (FACC) in September 1976 provided for spacecraft to meet those requirements. The spacecraft have been built under FACC's leadership with substantial participation by European and Japanese companies.

As would be expected, the first two Intelsat Vs to be launched will be deployed as the Atlantic Region Primary and Spare; the next two Intelsat Vs will be launched to serve as Indian Ocean Primary and Spare.

History of Growth

Each successive generation of Intelsat satellites has improved communication capacity, and the Intelsat V is no exception. The Intelsat I, Early Bird, launched in 1965, provided a choice of either 240 voice circuits or one television channel between the United

Ford Aerospace and Communications technicians assemble Intelsat V at FACC facility in Palo Alto, California.

States and Europe, more than doubling the then-existing submarine cable telephone capacity and initiating transoceanic television service.

With the Intelsat V, frequency reuse techniques have been developed with the introduction of polarized transmission. This technique, already in use in U.S. domestic systems, permits radio waves to be generated at the same frequency, oppositely polarized, without mutual interference, thereby doubling the effective bandwidth. Coupling this technique with sophisticated antenna designs permitting a further reuse of frequencies through beam isolation, a fourfold reuse of portions of the 6/4 GHz spectrum is achieved. When combined with twofold reuse of the 14/11 GHz bands through beam isolation, a total spacecraft bandwidth of 2280 MHz capable of carrying 12,000 circuits plus two TV channels and other miscellaneous services is achieved.

The Intelsat V is the first Intelsat spacecraft to utilize a three-axis body stabilized rather than a spin-stabilized design. The solar arrays which power the spacecraft therefore can continuously track the sun, while the spacecraft bus and antennas continually point at the earth. The solar arrays when fully deployed span nearly 16 meters, roughly the height of a five-story building. Later spacecraft in the Intelsat V series will also probably employ nickel hydrogen batteries, a technology developed by Comsat Laboratories under Intelsat sponsorship.

As a result of such technology advances, the Intelsat V represents the highest capacity commercial communications satellite in orbit.

Domestic Services

In addition to meeting the international services requirements outlined above, the Intelsat V will provide capacity to assist Intelsat in meeting the domestic service needs of its members.

A major element of the Communications Satellite Act of 1962, which created Comsat, was the goal of ensuring that the benefits of satellite communications would flow to all areas of the world, developed and developing. This goal was reiterated in the Intelsat Agreements. One way of meeting this goal, in addition to the provision of expanded international telecommunications services, has been through the provision of leased capacity on Intelsat satellites which member countries use to implement integrated and expanded domestic communications networks. Intelsat offers leased transponders for domestic services on both a fully shared and a preemptible basis, at different rates, the latter form of lease having been established in 1975 at the request of Algeria. Provided on spare space segment capacity for a minimum of five years, the preemptible service is offered at a lower charge than that for normal full-time utilization, and has led to a tremendous growth in the use of the Intelsat space segment to meet domestic service requirements. There are presently fifteen countries using seventeen full transponders for domestic service. Since 1975, preemptible leases have brought approximately $38 million in revenue to Intelsat; realized at no incremental cost and minimal operating and maintenance cost to the Organization, the service has been beneficial to both Intelsat and all its member nations.

As the demand for leased transponders increases, operational satellites serving international traffic, especially in the Atlantic and Indian Regions, will not have capacity to meet domestic requirements, and the likelihood of preemption of these leases also increases. To ensure the continuity of domestic services, the Board of Governors has recently decided to plan for the provision of capacity specifically for domestic services, rather than using such spare capacity as is available. For these reasons, a ninth Intelsat V was procured, which will ensure Intelsat's ability to continue to fulfill the domestic service requirements of its members.

Maritime Communications

The third multi-service aspect of the Intelsat V is its ability to provide maritime communications. The later Intelsat V flight models will carry a maritime communication subsystem (MCS). This capacity will be leased to the International Maritime Communications Satellite Organization (Inmarsat) as a major part of the international maritime system which Inmarsat is establishing. The Intelsat V locations chosen to meet the requirements of international fixed services will also provide suitable maritime service coverage, so that maritime and international services can be provided on a single spacecraft. This maximizes the use of limited orbital space and results in cost savings to Inmarsat by eliminating the need for construction and launch of separate spacecraft.

Earth Segment

The earth segment of the Intelsat system at end-September 1980 consisted of 183 international antennas at 146 earth stations in 110 countries. (As Intelsat is a truly global system, even non-members may have access to it.) The technical characteristics of the Intelsat V have required the construction of new antennas for operation at 14/11 GHz, as well as modifications to existing operational antennas. Preparations for these changes have been in progress for a number of years. Intelsat has developed performance specifications for stations which will access the Intelsat V and has held earth station technology seminars to acquaint earth station owners and operators with the new technology, required engineering, and test procedures. It should be noted that the responsibility to invest in and operate earth stations rests with each individual Signatory, in contrast to the space segment, which is planned, owned and operated by Intelsat. The matching of the earth segment to new space segment capabilities through modification of existing earth stations and installation of new antennas is performed on a voluntary basis by Signatories.

Nevertheless, the earth segment will be ready for Intelsat V operation. By year end-1980, over 100 antennas had been or were in the process of being modified to operate in a dual polarized mode with Atlantic and Indian Region Intelsat Vs. Among these are all four of Comsat's East Coast antennas—two at Etam, West Virginia, and two at Andover, Maine.

The introduction of operation at 14/11 GHz has required the construction of new earth stations specifically designed for this purpose. Since the signals received at 14 and 11 GHz are subject to degradation in heavy rainstorms, diversity antennas geographically separate from the main site are also often needed. Currently, the U.S., France, Germany and the United Kingdom are constructing 14/11 antennas. The U.S. 14/11 antenna at Etam, West Virginia, will become operational in 1981. Additional 14/11 GHz antennas will be added in the future, primarily for high traffic routes.

Transition

Transition of traffic from the Intelsat IV-As to the Intelsat Vs will be one of the most complex telecommunications operations in Intelsat's history due to the introduction of frequency reuse operations and to the multiple transponder bandwidths and interconnection arrangements of the V. The Intelsat IV-A, for example, has approximately 100 transmit carriers, any combination of which can be assigned to a given earth station or a combination of earth stations. The Intelsat Vs, on the other hand, will have at least 200 carriers. The Intelsat V system will also permit operation in the "cross strap mode" in which a carrier is transmitted at 14 GHz and received at 4 GHz, or transmitted at 6 GHz and received at 11 GHz.

Transition of the heavily loaded Intelsat IV-A Atlantic Primary to the Intelsat V will require more than one phase, because of the number of circuits and satellite paths involved. In the first stage, some traffic will be off-loaded from the Primary to other satellites in the region until an appropriate level is reached that can be transferred to the V. When the initial transfer is complete, twenty-one countries will commence operation in the dual polarization mode. Three 14/11 GHz antennas are then expected to be activated, (U.S., France and Germany) and as additional countries will by that time have completed modifications to their antennas, the second stage of transition can begin to more evenly distribute traffic between polarizations and at different frequencies. As may be seen, transition arrangements call for cooperation and detailed planning between Intelsat and all member and non-member users.

Conclusion

The Intelsat V was designed in the mid-1970s to meet traffic requirements of the 1980s; as such it embodies a necessary compromise between the desire to implement technological advances and the recognition of commercial realities. While the specification for the Intelsat V had to incorporate innovations in technology to provide an appropriate increase in capacity, it also had to be clearly within the realm of manufacturing possibility. Successful as that compromise has been, and as pleased as we are with the new era about to unfold, the need for constant improvement and growth was demonstrated when, in the wake of the first Intelsat V launch, the Board of Governors agreed to purchase three modified versions of the Intelsat V (Intelsat V-A), each one to provide an additional 3,000-5,000 half circuits which will be needed as the Vs themselves saturate. The most exciting aspect of the launch of the Intelsat V is thus perhaps that it is only the latest in what must be a series of notable technological developments to meet new challenges in telecommunications.

Earth Station Changes for the Intelsat V Era

by Robert W. Kinzie, Vice President,
Project Management and Development,
International Communications Services

The rapid growth of communications traffic "via satellite" between nations is partly the result of, and partly the reason for, the accelerated expansion of our U.S. international earth stations.

Satellites are the glamorous players on the international telecommunications stage. Dramatically launched into synchronous orbit and continuously monitored and controlled by specially equipped earth stations, the satellite is the essential element that has made this new method of communication possible...a radio relay in the sky.

A communication satellite, however, is actually a repeater that receives signals from and re-transmits them to earth. Once placed in service, it remains basically unchanged throughout its useful life.

In contrast, earth stations are continually being modified to accept and process signals in a wide variety of ways, e.g., new equipment is added to increase message traffic capacity, new channel groupings are set up to provide special services, and television carriers are programmed into the system to meet network requirements. When a new satellite such as the Intelsat V is launched, the necessary earth station modifications, long since planned, must be ready. Despite the 22,300 miles that separate them, the satellite and its associated earth stations function as a tightly-coupled, highly interdependent signal processing system.

Under the direction of Irving Goldstein, Senior Vice President, International Communications Services (ICS) is responsible for the development, construction, operation and management of the U.S. international earth stations which are owned by Comsat in conjunction with AT&T, ITT, WUI, HAWTEL, and RCA. These earth stations are located in California, Hawaii, Maine, Washington and West Virginia. ICS is also responsible for the Comsat-owned earth stations in American Samoa and Saipan, and the Telemetry, Tracking, Command and Monitoring (TTC&M) earth stations located in Hawaii and Maine, and is a part owner and system manager of an earth station is Guam.

International Communications Services, a part of Comsat World Systems Division, is the key participant in an intricate system of activity that is carefully coordinated and performed in cooperation with Comsat customers and fellow earth station owners (the international voice and record carriers), and with communications entities in more than 100 other countries. In ICS, one-Year, Five-Year, and Ten-Year Plans covering traffic projections, technological developments, economic considerations, and many other factors are regularly reviewed and updated. Appropriate new construction projects are initiated as required to insure that the required new and replacement equipment is available at the earth stations on a timely basis.

When the Intelsat V program was formally instituted, ICS became committed to an extensive effort involving major modifications and additions to the existing earth stations at Etam, West Virginia and Andover, Maine. Plans were also begun for a new earth station on the East Coast to meet the operational requirements of the Intelsat V as well as expected future traffic.

Since Intelsat V receives and re-transmits signals at 6.0 and 4.0 GHz respectively, in two opposing polarizations (earlier satellites worked with single polarization), the "dual-pol" traffic handling capacity of each antenna, after modification to work with Intelsat V, is doubled over that of the original design.

Additionally, the capability of Intelsat V to receive and re-transmit single polarization signals in the 14.0 and 11.0 GHz bands required that a new, 60-foot antenna with all the associated earth station equipment be built at Etam to handle some of the Atlantic Ocean Region traffic in these bands.

Because the 14/11 GHz signals are subject to attenuation by rainfall, a diversity station with an identical antenna some 20 miles distant at Lenox, West Virginia, linked to the new station at Etam by a microwave facility, is planned.

To meet the requirement of operation in the 14/11 GHz band on a second Intelsat V in the Atlantic Ocean Region, ICS is now proceeding with work on the new "Third East Coast" earth station, mentioned previously. This new station will have antennas to handle traffic on both polarizations in the 6/4 GHz bands, and single-polarization in the 14/11 GHz bands. As with

32 foot diameter dish for new 14/11 GHz Standard C antenna at Etam, West Virginia, earth station moments before it's lift into place atop antenna's alidade structure.

Steady as she goes. Lifted by a 120-ton crane, dish for new Standard C antenna at Etam, West Virginia, earth station rises into the air.

the new station for Intelsat V at Etam, a diversity station with a terrestrial microwave link to the main station is planned.

Although the physical plant that interfaces with U.S. terrestrial communications facilities is located at the earth stations, activities such as processing orders for new circuits, detailed frequency assignments, earth station channel configuration, and day-to-day operational control are all handled at Comsat Headquarters in Washington. The recent rapid expansion of international traffic through U.S. earth stations has placed a heavy load on existing operations. Consequently, a new system consisting of dual-redundant mini-computers at Comsat Headquarters and at U.S. earth stations and interconnected by dedicated message/data links, is presently under construction. This new system, labeled the Network Management Action System (NMAS), will contain the data base and special computer programs required to monitor, display, control and update the operational status of the earth stations, thus relieving the pressure on the message system, and providing for more efficient network management and monitoring and control. A highly useful adjunct to the new NMAS system is the provision for data communication with the Comsat Maintenance and Supply Center at Clarksburg, Maryland. This will greatly facilitate keeping up-to-date inventories of spare parts and rapid response in the shipments of maintenance items.

At the beginning of 1981, the status of some of the more important development projects related to the introduction of the Intelsat V was as follows:

- New telemetry, tracking, command and monitoring (TTC&M) antennas at Andover, Maine, and Paumalu, Hawaii, developed for Intelsat V, have been constructed.
- The 14/11 GHz station at Etam, West Virginia, is expected to commence commercial operation by mid 1981.
- A System Monitoring facility was installed at Etam under contract to Intelsat to handle both the 6/4 and 14/11 GHz bands.
- All four U.S. Standard A antennas operating in the Atlantic Ocean Region (two each at Andover and Etam) are being modified to handle dual polarization signals at 6/4 GHz for operation with Intelsat V.
- The Third East Coast station is in the early stages of development.
- ICS is developing plans for modifications to the Pacific Region earth stations for operation with a future Intelsat V in that region.
- The new Network Management Action System is well under way; the mini-computers have been delivered, and software and interface plans are being developed.
- An advanced system for accessing satellites on a time-division-multiple-access (TDMA) basis is currently undergoing field trials at three Pacific Ocean Region earth stations.

The work of International Communications Services does not stop with preparations for Intelsat V. By 1984 the demand for circuits in the Intelsat system is expected to be twice the current number. So, for the next four years, ICS, in addition to completing the construction of the Third East Coast Station, must add enough new equipment to existing earth stations to accommodate an amount of traffic equal to that gained over the previous 12 years, and that number is expected to double again by the latter part of the decade. It is also expected that future satellite designs will incorporate new frequency allocations made by the 1979 World Administrative Radio Conference to handle this traffic. These factors, too, must be taken into account by International Communications Services in its planning of earth stations and the new equipment the stations will depend on.

The 1980s will be a busy decade for ICS. Tremendous demand for international satellite communications services and the advent of new large-capacity satellites are both anticipated. However, these innovative satellites cannot perform without earth stations which have state-of-the-art equipment and antennas to handle new frequencies and new modulation and access techniques, and greater volumes of traffic. There will also be more links to countries in the Intelsat community as well as more high speed digital links to interconnect computers via the satellites.

Therefore, one of the more important activities of ICS is planning for the future—both in space and on the ground. Our engineers and managers must carefully estimate future demand, identify the technology which will be available, and develop and implement the plans to insure meeting this demand.

These are just *some* of the challenges facing ICS during the 1980s.

THE SATELLITE,
Comsat's role

by Louis Pollack, Vice President
Intelsat Technical Services

A major interest of **Comsat** is the technical integrity of the Intelsat system. To emphasize the importance of the technical services performed by **Comsat** for **Intelsat**, **Comsat** grouped together these services into a distinct entity, Intelsat Technical Services (I.T.S.), under Dr. John L. McLucas, President of **Comsat** World Systems Division. I.T.S. shares the Division's role in international communications and **Intelsat** with International Communications Services and **Comsat Laboratories**.

The technical activities now grouped under the heading of I.T.S. have an exciting history at **Comsat** dating back to 1964 when they were under the direction of Sigmund Reiger. Now, 35 satellites and launches later, **Comsat** looks forward to still more activity from the perspective of a wealth of technical development and practical experience in the design, implementation, operation and maintenance of communications satellites.

We recall that the initial **Intelsat** organization was brought together under an Interim Communications Satellite Committee headed by the United States and composed of 10 member nations. The Interim Committee established the worldwide system with participation by **Comsat** as majority investor, manager and operator of the global system. The Interim Committee in operation for 8 years was replaced with a permanent organization in February 1973.

The Board of Governors of **Intelsat**, in establishing a permanent management organization, provided that the wealth of experience and knowledge at **Comsat** should be sustained in the Intelsat system, first through a Management Services Contract and later by the present Technical Services Contracts and the Laboratory Service contract.

Comsat's I.T.S., through these contracts, provides: 1) the engineering and other technical support related to Intelsat V and other satellites in the Intelsat system; 2) the definition of the technical aspects of new satellites which will follow the Intelsat V series; and 3) technical assistance to **Intelsat** in areas requiring expertise and equipment not available in the office of the Director General of **Intelsat**.

Under a six-year contract (dated November 1978), referred to as the TSC-6, **Comsat** furnishes the technical expertise to thoroughly monitor the Intelsat V satellite manufactured by the Ford Aerospace and Communications Company in Palo Alto.

The **Comsat** offices at Palo Alto and El Segundo, California, and Cannes, France, consisting of a team of 35 people, provide detailed engineering evaluation of the design, manufacture, test and launch of the satellites. This currently includes nine Intelsat Vs (four with maritime packages) and three Intelsat V-As.

In addition, under other elements of the TSC-6, **Comsat Laboratories**, along with engineering personnel at **Comsat** headquarters, provide technical support to those engaged in the "in-residence" monitoring. Other elements of the contract call for orbit determination and control, assistance in satellite operations, satellite problem evaluation, assistance with launch vehicle engineering, and various pre-operational and in-orbit tests to determine satellite performance.

Satellite System Design

To assist the Executive Organ of **Intelsat** in planning and engineering the Intelsat VI, a second contract, known as the Technical Services Contract-Four Years (TSC-4), was established to define the technical specifications and statement of work for the new generation of satellites which will follow the Intelsat V.

Under this contract, I.T.S. engineers at headquarters and at Palo Alto and El Segundo, in conjunction with **Comsat Laboratories** experts, assist the Executive Organ in analyzing and choosing technical alternatives for future satellites.

With international communications requirements expected to approach 200,000 equivalent voice channels early in the 1990s and the Communications Satellite Act of 1962 requirement that we make "efficient and economical use of the electromagnetic frequency spectrum," complex alternatives must be carefully evaluated before we can choose the most cost- and service-effective satellite design.

At the end of the first quarter of 1981, **Intelsat** will issue a Request For Proposal (RFP) for Intelsat VI. I.T.S. and the supporting staff at Comsat are helping Intelsat develop the specifications. We will assist in evaluating proposals and support contract negotiations for the space segment expected to be contracted to a major spacecraft supplier early in 1982.

The TSC-4 includes among the engineering tasks the modifications of Intelsat V and its specifications, and subsequent design, manufacturing and test monitoring. As a result of this activity, Intelsat recently completed developing specifications for an Intelsat V-A, which will increase the capacity of the system and assist in the transition from the V to the VI.

The V-A and later modifications of the V, specifically the fifth through ninth satellites in the V series, will carry a maritime package to supply communication services to ships at sea.

Communication satellites to provide service to 105 nations, with a wide range of telephone, data and video needs, must be flexible in design. This flexibility is evident in the Intelsat V with its transmission capacity of 24,000 voice channels plus two television channels.

Spacecraft Engineering

The satellites operating over the Atlantic, Pacific, and Indian Ocean must be adaptable to the wide range of requirements of these three ocean areas. For instance, the Atlantic ocean region traffic at the end of 1980 was approximately 28,000 channels and is expected to grow to over 100,000 by the end of 1990.

In the Indian Ocean region, the corresponding numbers are 10,500 and 41,000 whereas in the Pacific Ocean, the numbers are 4,000 and 15,000.

Another essential requirement that must be met by every Intelsat design is extremely high reliability. Specifications for Intelsat V call for the probability of the satellite's operating for two months after launch of .99 and a probability of .75 that 65 percent of the RF channels in each coverage area are operating after seven years. With over 50,000 parts in the Intelsat V satellites, we can see that this is a most difficult task. Evaluating the design and testing of such satellites involves many engineering specialities. An example is structural engineering which encompases lightweight, strong structures using exotic materials such as graphite fibers with epoxy binder or alloys of aluminum and magnesium.

The wide range of temperatures that external spacecraft parts can reach in space—from −170 to 200 degrees C—requires knowledgeable selection of devices and materials and/or careful heat transfer control. Surfaces must be treated to reduce temperature variations and also to withstand the bombardment of electrons and protons emanating from the sun.

Mechanisms that include high speed (e.g. 3,500 rpm) momentum wheels, as well as very slow speed (one revolution per day) motors to orient the solar array to the sun as the satellite rotates around the earth, requires knowledge of lubricants and materials to yield long life as well as designs that are power efficient and very lightweight. Other mechanisms, e.g., unfurling spacecraft antenna parts, only operate once but must do so with extremely high certainty.

All the power for the satellite is derived from the sun and this requires not only knowledge of photovoltaic devices, but effects of solar radiation on material properties and the complementary knowledge of electronic circuits to control and transform the electrical power, as well as to store it during eclipse periods.

Monitoring and controlling the satellite in synchronous orbit to maintain its station to a precision of $\pm 0.1°$ requires knowledge of orbital mechanics and control dynamics. Specialists in these areas monitor the work of designers and manufacturers of rocket engines and the automatic control of these attitude and stationkeeping mechanisms.

And, of course, in the communications area, engineers who are thoroughly experienced in the design of microwave receivers, transmitters, antennas, as well as the devices, e.g., transistors and travelling wave tubes associated with these circuits, must carefully evaluate designs and test data during the life of the manufacturing operations and the spacecraft in orbit.

But equally important are the engineers who focus on the integration and test of the many subsystems and on the total reliability and quality of the satellite. These engineers must bring together the knowledge of all the specialists mentioned previously and effectively evaluate the equipment so that its reliability and potential life time can be properly judged, or better still, measured.

Continued next page

Launch Control Center, Orbital Mechanics and Satellite Monitoring

Following rigorous testing the satellite is shipped to Cape Canaveral. Here it is reassembled, retested and mated with the launch vehicle. Putting the satellite in orbit requires a detailed knowledge of the various booster rockets and their characteristics. And it requires the ability to control the satellite after liftoff and guide it to the proper orbit and station where it will serve the assigned community of users.

The launch involves a complicated series of trajectory measurements, and commands to the satellite to maneuver it into the proper attitude and unfasten various stowed elements such as solar arrays and antenna reflectors, allowing them to deploy into their operating attitudes. The launch operations use the computers and other instrumentation at Comsat's Launch Control Center. Analysts and astrodynamicists in the Satellite Monitoring and Orbital Mechanics and Data Analysis groups study the spacecraft orbital motion and attitude using data from Intelsat tracking stations and on-board attitude sensors.

Initially the information is used to achieve the proper orbit, but during the lifetime of the satellite the orbit is readjusted to compensate for solar pressure and gravitational disturbances. Telemetrical data is constantly evaluated to check the health of the satellite.

Comsat's Launch Control Center inaugurated operations with the flawless launch of SBS 1 on November 15th, 1980. The first of the Intelsat V series of satellites was successfully launched on December 6th, 1980.

During 1981, I.T.S. will be working closely with the Intelsat Director General's staff and Ford Aerospace and Communications Corporation to complete and launch four more Intelsat Vs. Interspersed will be launchings of Comstar IV and SBS-2.

Laboratory Services

Under the Laboratory Services Contract, with the help of Comsat Labs, Intelsat's research and development work is supported through efforts in exploratory research and studies and assistance to developmental projects.

Intelsat has conducted a research and development program, with Comsat's assistance, since 1968. In 1981 the Intelsat R&D budget is $11.4 million with about $1.8 million allocated to Comsat for ER&S and about $1.2 million for support in the test and technical evaluation of contracted development projects.

Various aspects of the communications systems must be tested and evaluated prior to initiating service or to solve problems that have arisen. This activity is covered under the Communication Engineering part of the Lab Services Contract and includes system simulation. During 1980, for instance, operation of the Intelsat V satellite has been simulated with representative pieces of hardware. Tests of the forthcoming Time Division Multiple Access (TDMA) system, which will more than double the capacity of each transponder, have been conducted in this simulation facility.

A major modification to the Intelsat system will take place during 1982 with the introduction of TDMA. The equipment specifications and system protocols have been developed by Intelsat with the help of Comsat, as part of the communication engineering portion of the Laboratory Services Contract.

The third part of the LSC includes equipment engineering which provides for the design of specialized equipment and its integration into the Intelsat monitoring and measurement system. Examples of this are the equipment for testing the performance of Intelsat V satellites after launch to establish the satellite health and initiate incentive payments to the contractor where applicable.

This computer-controlled equipment, representing years of in-orbit test experience, was designed by Comsat Labs and two sets have been delivered and installed; one at the Fucino, Italy earth station and the second in Japan at Yamaguchi earth station.

Intelsat Technical Services including launch services, orbit analysis and technical support to SBS and Comsat General is expected to achieve revenues of about $18 million during 1981 with about $9 million allocated to Comsat Labs.

The people of I.T.S. look forward to a continuing role in expanding Comsat's technical leadership in satellite communications and to contributions to Intelsat's success.

An Inventory
THE SATELLITES IN GEOSYNCHRONOUS ORBIT

by Walter L. Morgan

The chart on the following two pages shows the approximate locations of the geosynchronous satellites providing both domestic and international services. Shown are the active satellites presently in orbit and the proposed future spacecraft. When Early Bird was launched in 1965, it joined two other satellites (Syncom-II and Syncom-III) in orbit. When Intelsat V was launched in December, there already were over 60 operating communications satellites.

This tremendous growth over a period of 15 years is a testimony to the success of communications satellites, Intelsat and particularly Comsat. The diversity of the satellites is an indication of the wide range of opportunities available.

The success of Intelsat has encouraged certain regional satellites such as the Soviet Union's Statsionar series—which includes Raduga, Loutch & Gorizont,—the Arabsat satellites, the Southeast Asia Palapa and the European Eutelsat (also called ECS). In spite of the development of these other satellite systems, the Intelsat growth rate continues at greater than 20 percent per year compounded.

Domestic satellites have also been developed for a single nation. The United States has its present Satcom, Westar, and of course, Comsat General's Comstar satellites. Recently approved were applications to provide service by the Southern Pacific Communications Company, the General Telephone and Electronics Corporation, the American Telephone and Telegraph Company and the Hughes Aircraft Company. Other domestic systems are operational in the Soviet Union, Japan, France, Canada, Mexico and other nations.

The legends at the bottom of the chart identify the various satellites shown in the chart. The satellites shown in red are systems which the Comsat family of companies uses or has had some role in building. The participation may range from owner, partner, advisor or experimentor.

It ought to be apparent from a close review of the chart that the world consumer has a diversity of sources of satellite communications services. This diversity is present both in the form of the offering entity and in the type of services provided.

Satellite Business Systems' SBS-1 is the first of a new class of domestic satellites intended for digital transmission of voice and data services. Comsat General is one of the three partners in the SBS organization.

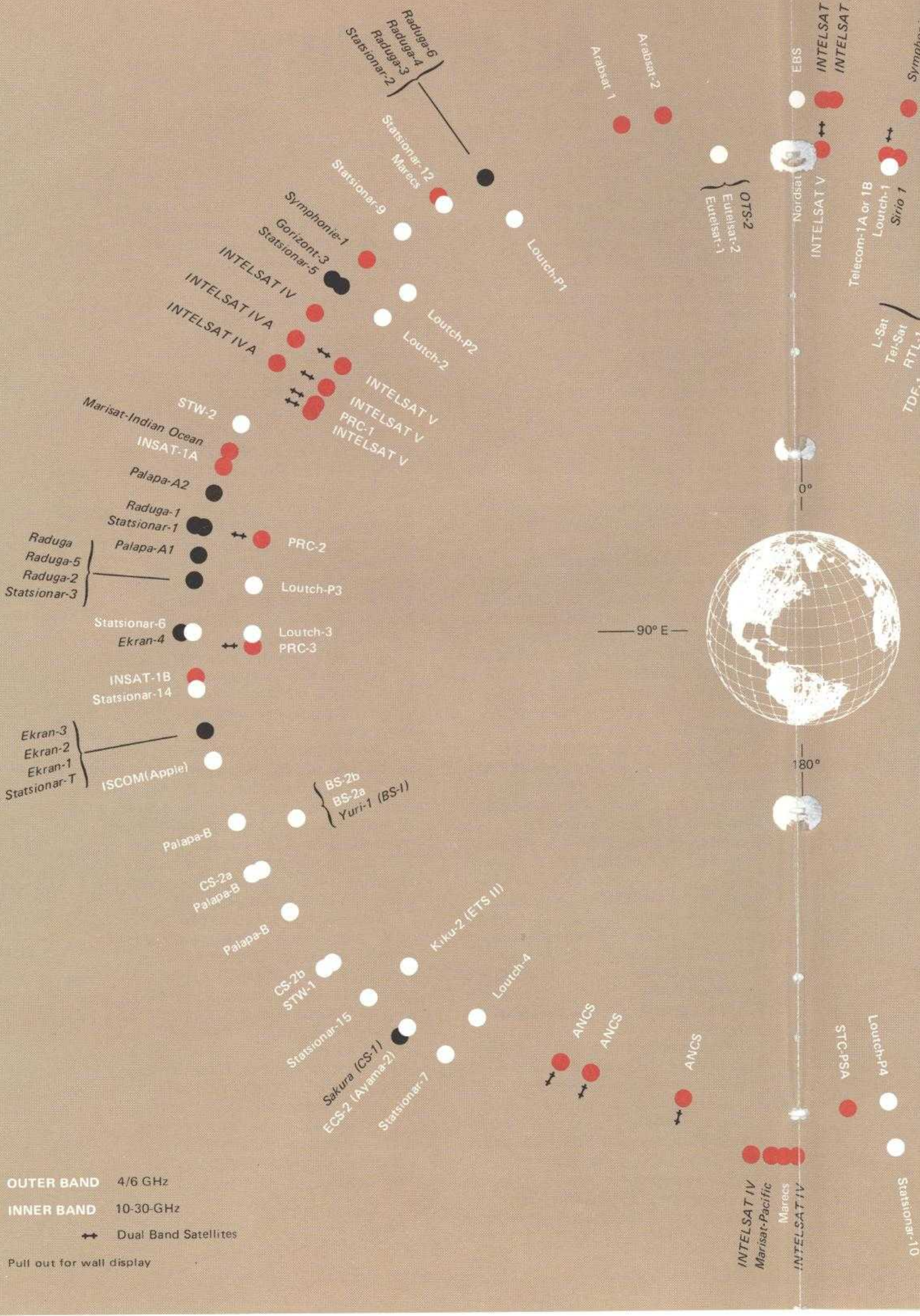
Mobile satellite services (such as Comsat General's Marisat) and the Maritime Communications Subsystem on some of the later Intelsat Vs provide service to ships and ocean platforms throughout the world. These will be incorporated in the new Inmarsat consortium, of which the Comsat World Systems Division is a member. International communications to and from the United States that flow via the Intelsat satellites are handled by World Systems Division.

Comsat's Satellite Television Corporation (STC) is planning four broadcasting satellites to provide television directly to the homeowner from space.

Among the other satellites in which the Comsat group has participated are the CTS, ATS-6 (neither are in use now) and Sirio. The group is providing technical assistance for the next generation of satellites for AT&T (Telstar 3-A to 3-C) and those seeking to launch satellites in behalf of Australia, Colombia, Alaska and the Arabs (Arabsat).

The chart does not, of course, reflect the earth-bound achievements of these and other Comsat family members. For example, the echo cancellor is a joint development of Comsat Laboratories and Comsat General TeleSystems, Inc. It has removed a major objection to satellite voice communications. These devices are also usable for removing echo from terrestrial circuits and even theaters.

In the future, one can assume that there will be opportunities to provide still other communications services "via satellite."



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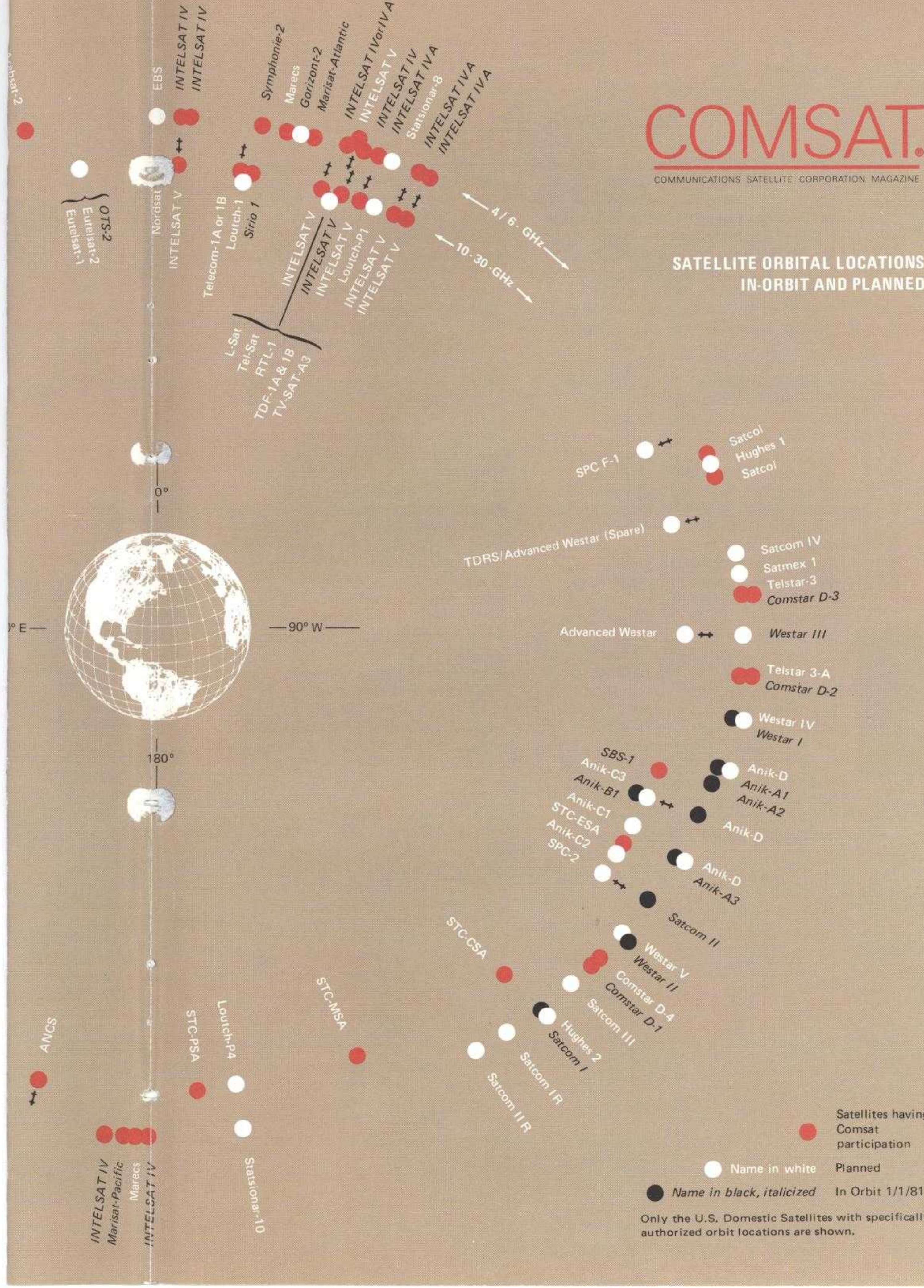
COMMUNICATIONS SATELLITE CORPORATION MAGAZINE

SATELLITE ORBITAL LOCATIONS IN-ORBIT AND PLANNED



COMMENTARY

by Dr. Delbert D. Smith
Senior Vice President, Corporate Affairs,
Communications Satellite Corporation

Ours is a visionary industry, as epitomized by the development and launch of the space shuttle orbiter Columbia. Ten years ago it was envisioned that a more efficient and economic means for routine access to space was necessary in order to allow the space applications industry to expand. We are fortunate that a decade ago there were numerous visionaries who instigated the shuttle effort.

There were the planners, the scientists and others within NASA who initiated the "Phase A" studies of reusable-rocket transportation systems during the late 1960s. There were the leaders within the Congress and other elements of the government which struggled through the space shuttle authorization votes and appropriation votes of 1970. There were the managers, engineers and other professionals who brought the program to fruition. We owe a debt of gratitude to all these visionaries; for they have made possible the means by which space applications can be expanded.

Yet it is important to realize that the development and launch of Columbia is not the ultimate goal; but rather that it is a milestone in the progress towards achievement of more benefits from space utilization. The immediate operational value of the shuttle program is apparent as evidenced by the fully booked shuttle manifest and consideration of additional orbiters to serve the demand for future launches. However, the visionary role must be exercised today, as it was exercised in the past, in order to lay the foundation for the expanded needs of tomorrow.

The shuttle program affords the opportunity to expand in several areas. First, the shuttle itself can be upgraded in areas of thrust augmentation and methods to extend orbital duration. Second, efficient and economic methods of moving payloads from low-earth-orbit to geostationary-earth-orbit can proceed. Third, utilization of the shuttle capabilities to insert larger and heavier payloads economically into space, and to construct geostationary platforms and other large space structures, can be pursued. Fourth, the design and development of fully reusable launch vehicles can be considered.

These are merely four of the many areas of opportunity for progress in space applications that are made possible by the shuttle program. All areas require commitments of time, talent and resources. However, the motivating force, the instigator, the impetus for these commitments is the visualization of the future capabilities and potential benefits that can be achieved. It is up to us to exercise the visionary role articulately and effectively for continued progress. Let the Columbia not only be a symbol of achievement, but also a symbol of our visionary role for the future.

SPACE, COMMUNICATIONS, AND THE FUTURE

The launch of the first of the Intelsat V series of communication satellites in December marked another major advance in satellite communications and serves to remind us of the rapid pace of development in this technological area. Even the most disinterested observer has to be amazed at the speed of our entry into what many have called the age of communications. This pace can only accelerate as public and private sector awareness of this technology's potential increases.

It's worth taking a look at how far we've come in the last fifteen years. In 1965, Early Bird, the first commercial communications satellite, was launched with the capacity to handle the bandwidth equivalent of 240 two-way telephone circuits; Intelsat V, launched in 1979, has a capacity of 12,000 two-way telephone circuits. During this fifteen-year period, total channel capacity of a single communications satellite has increased by a factor of 50 and the cost per circuit-year has decreased by about a factor of 45, a rate of investment cost improvement of 30% per year. Intelsat IV satellites provide more capacity than the entire network of transatlantic cables; and intercontinental TV transmission, now a commonplace, is provided entirely by satellite.

The information and communications industry is enjoying that period of rapid advance that follows the successful bridging of the gap between research and development and successful application to social needs. It seems presently as if the only limits to its further growth are the limits set by human imagination. A more studied examination of future communication developments, however, reveals some constraints that may set limits on present growth trends. But these limits can be extended if imagination and innovation are applied here as well. Necessary to this process is an adequate process of analysis and planning that takes all of the potentially constraining factors into account.

Most industries in an innovative expansion phase continue to develop until encountering physical, technological, or political and social constraints. In the satellite telecommunications field, all of these elements seem to have a role to play in shaping the future of the industry.

Increasing demand for satellite communications services is putting strains upon present transmission capacity. By most estimates, the total commercial demand by the year 2000 will be at least an order of magnitude greater than today's capacity. At the same time, technological advances make possible, and new applications require, satellites with different operating capabilities. The result is a need for more satellites and thus more geosynchrous orbit locations and more broadcast spectrum allocations. Add to this the demands of military satellite communications and navigations applications and the emerging demands from other countries in the Americas, and the physical limits of the broadcast spectrum and a finite number of geosynchrous "parking spaces" come into focus.

Beyond these physical constraints, there are important political and social considerations involved in the future of telecommunications, both in this country and internationally. Domestically, we seem to be lurching slowly toward agreement on the broad outlines of communications deregulation, but we have scarcely begun the long-range planning needed to cope with the impact of technological advances in the information and communications field. Nor have we evolved anything approaching a coherent long-range policy for our space program as a whole. In view of the level of effort being directed at telecommunications planning in other countries, this country may find itself at a competitive disadvantage if we fail to develop and coordinate policy more effectively. The kind of planning needed can only be undertaken as a cooperative effort between government and the private sector, so that each may make the wisest use of its resources in research, development, and applications.

by the Honorable George E. Brown, Jr.
(Democrat-California), U.S. House of Representatives

Continued next page

On an international level, the political elements multiply, and this country's ability to control and direct events decreases. Intelsat has been successful and relatively free of contention, but domestic satellite telecommunications systems are also subject to international agreements and regulation, and are thus bound up in some of the international political debates surrounding information and communications technologies. Calls for a "new world information order" by some Third World nations have divided the international community. National pride and a desire not to be left behind in the age of communications have prompted some countries to seek spectrum allocations and geosynchrous orbit slots in advance of a proven satellite telecommunications capability. The capital costs of a national satellite system will probably prove to be well beyond the means of all but a few countries; for most, participation in some kind of regional organization may be the most promising prospect for domestic satellite service.

As a result of tendencies toward pre-planning of the satellite orbit, the establishment of a domestic satellite telecommunications system to meet U.S. needs may take on international political ramifications. We in government need to be increasingly sensitive to this and take steps to avoid unnecessary confrontations.

These physical and political/social constraints force a response which is, in part, technological, in that they force the need for more research and development work to overcome potential problems. It becomes obvious that the technology presently applied cannot deal with some of these problem areas in the long run. To be useful, new technological developments must be focused upon the most pressing physical and political/social problems. A proper focus for R&D work requires that researchers, regulators, politicians, industry leaders, and foreign affairs experts operate within a framework of shared goals. Most importantly, this process, to be effective, must have the benefit of careful planning to guide the way.

The studied examination of the satellite telecommunications field that reveals constraints also yields some promising courses of action to avoid these constraints. Research advances, for instance, can ease some of the physical constraints to the continuing expansion of telecommunications. Broadcast spectrum crowding in currently used frequency ranges is an area that needs continuing research attention. The work now being done by NASA on overcoming the difficulties of using the 20/30 GHz range for satellite telecommunications is an important step. While this frequency range will not be suitable for all uses or all users, practical expansion of the broadcast spectrum into the 20/30 GHz range can relieve some of the constraints on presently used frequencies. Other research efforts of high priority should be work on broadcast bandwidth compression and the development of satellite configurations that allow closer spacing of broadcast frequency allocations and closer physical spacing of satellites.

Advances in the political/social area can help alleviate physical limitations as well. Aggregating users can reduce pressures for establishing independent satellite telecommunications systems, each requiring its own broadcast frequency and satellite "parking space." Innovative time-sharing arrangements can also work toward overcoming these physical constraints. The combining of NASA and Western Union commercial needs on the TDRSS/Westar system is a good example of this.

In spite of the efforts put forth by the National Telecommunications and Information Administration, the Federal government itself has had only limited success in coordinating user demand. Some of the problems in this area stem from the reluctance of the military to share systems with civilian users; the enunciation of more coherent policy guidelines would facilitate this coordination. I hope to see progress toward the resolution of these problems in the 97th Congress, and I hope also to see the Federal government exploit opportunities to take the lead in demonstrating innovative uses of telecommunications.

But even if we are successful in our R&D efforts and in our attempts to more efficiently use limited satellite telecommunications resources domestically, we still face some problems internationally. Unless and until this country makes meaningful efforts at transferring satellite telecommunications technology to developing countries, we will see increasing dissension in the international community. These problems were successfully avoided at the recent World Administrative Radio Conference (WARC) but in future meetings we may not be so lucky.

Developing countries view satellite telecommunications with a mixture of envy and suspicion. Afraid of being cut off from the benefits of this technology, and afraid of continued domination by developed countries, some nations seek to hinder continued expansion of satellite telecommunications that does not include them. Other countries nearing the capability of developing their own satellite systems are working to insure that spectrum and orbit allocations are reserved for their use.

The same kind of aggregation and coordination that we seek domestically must be sought internationally. We also need to insure that any threats that developing countries see in this technology are dispelled. This is done most effectively by making the technology available to them, either bilaterally or through mechanisms such as Intelsat. The cost of these efforts will be repaid in elimination of constraints on our domestic systems that these countries could effect through their own unilateral decisions and through their voting power in the ITU and other international bodies. And there is considerable economic return in providing the hardware, software, and training for these countries, a fact that has not escaped the Japanese in their dealings with developing countries.

One point that needs to be stressed is that R&D advances alone will not remove international political/social constraints. For example, applications in the 20/30 GHz range, new satellite configurations, etc., will be more costly than existing technology and thus less attractive to developing countries. In the specific case of the work in the 20/30 GHz range, high rainfall in moist tropical areas where many developing countries are located presents a technological problem to be overcome in applications there. Any technology transfer done must be carefully fitted to economic, political, and technological capabilities of the recipient countries.

Where the needs of developing countries are concerned, the major barriers to the transfer of satellite technology today are institutional rather than technological.

In dealing with this dynamic system of possible constraints, it is important to identify the areas best left to industry. Again, a coherent planning process is needed to insure that the optimum division of responsibility is achieved. From the government's perspective, we should seek the minimum level of involvement and the least possible restriction of the private sector in assuring that public needs are met. From industry's perspective, there needs to be increasing sensitivity to the political/social aspects of satellite telecommunications applications.

One final element to be added to this dialectic is less easily dealt with, that of public service telecommunications. This area encompasses needs in education, health care delivery and training, emergency services, and other social welfare needs. As telecommunications applications increase, we must be sensitive to those vital functions of society that could benefit from this technology but are unable, without some assistance, to take advantage of it. More effort is needed to insure that these functions are not overlooked. The current National Telecommunications and Information Administration grant program to aggregate public service users is the type of program that needs to be receiving more emphasis.

The public service telecommunications applications offer a great opportunity for more efficient services at lower cost to the public. Applications in this area spread the benefits of telecommunications advances throughout society, avoiding the emergence of a new group of "have nots," an information "poverty class." As we enter the communications age, flows of information become as important as flows of money and a democratic society must be mindful of any imbalances that develop.

The future is illuminated with the promise of developments in telecommunications. While some difficulties may emerge, they will not be insurmountable as long as basic human needs, in our own country, and in the less developed world, are afforded paramount importance, that is, as long as this technology is rationally developed.

SAIPAN

Island in the western Pacific becomes latest community to be linked to the world via satellite

by James T. McKenna, Manager,
Media Services
Office of Corporate Affairs

The map shows that it is located 9,500 miles west of Washington, 1,400 miles south of Tokyo and 3,100 miles north of Sydney. This island located in the Northern Mariana Archipelago in the Pacific Ocean is Saipan, a U.S. Commonwealth.

Under the Corporation's mandate in the Satellite Act of 1962 to bring the benefits of satellite communications to all areas of the world, Comsat opened discussion on the possibility of building a satellite earth station in the Northern Mariana Islands. Staff of the Comsat World Systems Division talked with officials of the Micronesian Telecommunications Corporation (MTC), which is the authorized communications carrier for the Northern Mariana Islands, about building an international communications satellite facility on Saipan. The two organizations agreed to the need for international satellite services, and in November 1980 commercial satellite service began via the Pacific Intelsat satellite through a 45-foot Standard B antenna located at Susupe on Saipan.

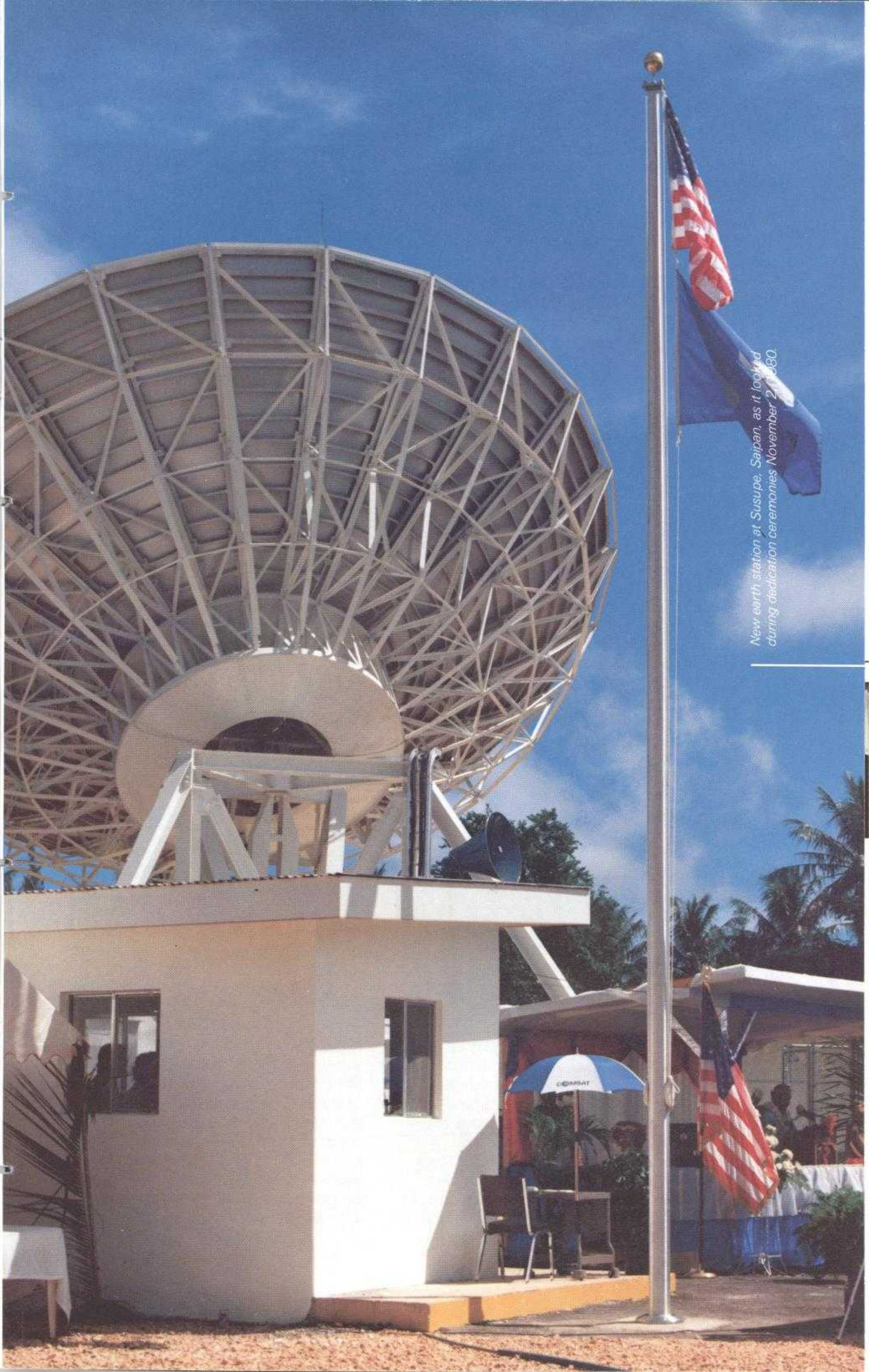
A dedication ceremony was held on November 2, 1980 to inaugurate communications service at the Susupe site. At the ceremonies, Dr. Joseph V. Charyk, President and Chief Executive Officer of Comsat, stated, "No longer need island cultures like your own remain out of touch. The satellite can include you no matter how tiny or geographically isolated you might be from major population centers. Today, distance from the U.S. mainland or from major shipping lanes becomes less of an obstacle to your continued progress and development . . . You are likely to agree that the shortest distance between two points is by satellite."

Many people know the Northern Mariana Islands as the site of some of the bloodiest battles of World War II—Saipan, the island, where in less than 30 days, 3,500 Americans died and 15,000 more were wounded.

Today an enjoyable place to visit, the Northern Marianas were named in 1668 in honor of Mariana of Austria, widow of Philip IV of Spain. The major islands in the chain are Saipan, Tinian and Rota.

Saipan's first mention in recorded history was in the account of its discovery in 1521 by Ferdinand Magellan. Magellan claimed the islands for Spain. In 1899, at the end of the Spanish-American War, Spain sold Saipan to Germany. In 1914, while World War I raged in Europe, Japan took the island without resistance. In 1920, the League of Nations mandated the island to Japan. In the ensuing years, the Japanese developed Saipan as a sugar producing center and as a military stronghold.

On March 12, 1944, the United States Joint Chiefs of Staff issued a directive for the seizure of the Marianas so that they could be used as bases for long-range bombers. Thus the course leading to one of the bloodiest battles of



New earth station at Susupe, Saipan, as it looked during dedication ceremonies November 2[illegible]1980.

World War II was set. The overall military code name for the operation including planning, logistics and invasions was Operation Forager.

Today, Saipan receives thousands of tourists each year, some to revisit scenes of World War II, others simply to enjoy the friendly people, clean air, tropical climate, and superb sunsets. The island is blessed with crystal clear waters and clean white sand beaches along its western shores. The peak of 1,550-foot Mount Topatchau affords breath-taking views of the entire island.

The population of Saipan is approximately 13,000, composed mainly of Chamorros whose major source of employment is the Northern Mariana Government and the rapidly-increasing tourist industry. Tourism, especially from Japan, is increasing at the rate of 20 percent per year.

The island is a military history buff's dream come true. There are remnants of World War II everywhere. When the winds howl around the island preceding a tropical storm you can almost hear the sounds of battle as you drive along the crushed coral roads and pass abandoned outposts, airstrips and artillery. Mortar shells, airplane parts and remnants of military structures are found everywhere, and the visitor can't help but feel that the war must have ended much less than 36 years ago.

From the beaches where today people swim and fish, one sees the remains of tanks and troop-landing vehicles that carried more than 64,000 American troops to some of the most devastating fighting in the history of mankind.

Saipan lost virtually all vegetation from the bombings and artillery barrages during the U.S. Naval assault. To prevent erosion, the United States, after victory was secure, loaded B-29s with a fast-growing weed known as tangantangan and dropped it over the entire island, thus keeping the soil from washing into the sea.

The immense destruction and loss of life on Saipan regrettably was due in part to a lack of proper communications. As the battle for Saipan came to an end, the defeated Japanese who were left behind committed suicide by the thousands rather than surrender to the Americans who, they feared, would torture and kill them. Quite the contrary happened. The 600 or so Japanese who were captured on the island were well treated by the American forces.

Improved telephone, telex, data and television service promise to invigorate the economic development of the Northern Mariana Islands. Up-to-date communication services form the heart of any strong economy and should increase business activity and thus bring about the creation of more jobs.

Carlos S. Camacho, Governor of the Commonwealth of the Northern Mariana Islands in his remarks at the dedication of the earth station, said this on that subject: "The establishment of this station brings us full-born into the Twentieth Century and gives us the facility for prompt, easy, and fool-proof communication that we must have if we are to compete successfully with other governments and if our business leaders are to have equal opportunity for success with the business leaders of other islands. These things are self evident and are reasons for giving each of us confidence and pride in the destiny that is influencing our course."

The installation of a system providing the most up-to-date link with the world's most up-to-date global communications system is likely to spur improvements in the island's domestic communications network. In Saipan, the Micronesian Telecommunications Corporation (MTC), which operates the Island's communication system, has been working with a system installed during World War II. The U.S. Government, which constructed the system, only intended to have it provide temporary service, but instead it has had to serve as the primary means of communications for the 13,000 residents of the island for over 35 years.

The communications cables are lined with paper and often become soaked and short out during heavy tropical rains. MTC is preparing to replace this old telephone system with modern up-to-date technology.

Comsat, which built an earth station in American Samoa in 1979, is planning to install still another Pacific Ocean region earth station in the near future—this one in the Republic of Belau. It is the Corporation's hope that the people of the Republic of Belau will soon be echoing the sentiments expressed by Northern Marianas Governor Camacho at the Susupe dedication, that they too will feel that their earth station has brought them "full-born into the Twentieth Century."

DBS

COMSAT'S TELEVISION PROPOSAL: PUBLIC INTEREST BENEFITS

by Richard E. Wiley
Kirkland & Ellis

In an important new initiative designed to deliver the full benefits of communications satellite technology to the American people, Satellite Television Corporation (**STC**), a wholly owned subsidiary of **Comsat**, applied to the Federal Communications Commission (FCC) on December 17, 1980 for authority to establish the nation's first direct broadcast satellite (DBS) system. Introduction of the new technology will enable **STC** to deliver three channels of diverse, high-quality television programming directly to the homes of subscribers to its service. This programming will be presented without commercial interruption.

Although future STC applications will request authority to implement DBS on a nationwide basis, the current proposal is limited to the establishment of a regional system which will provide satellite subscription television (SSTV) service to residents of the Eastern portion of the United States. The STC filing seeks authority to operate this "first phase" system on an experimental basis.

The new SSTV service holds great promise of delivering numerous benefits to the American public. Expeditious regulatory action, however, is an essential prerequisite to the realization of the public interest benefits of DBS.

Continued next page

Public Benefits

1. *New and diversified home video services available to consumers.* The STC service will assist in meeting the substantial, and growing, consumer demand for diversified and specialized home video offerings. SSTV will differ from the established media in various ways that are important to consumers. These include such features as nationwide availability of the service and greater breadth and variety of program offerings.

2. *Increased competition in the subscription television and program distribution markets.* The entry of STC will inject a much-needed element of competition into the subscription television and program distribution markets. At present, two firms control 85 percent of all subscriptions. The entry of STC should minimize the ability of entrenched firms artificially to hold down revenues to program producers and to increase costs to consumers.

3. *Stimulated programming production.* DBS will provide an important new outlet for program distribution. In addition, its ability to broadcast simultaneously different types of programs on three channels, and to offer some programs or series on a spcial subscription basis, will make it financially attractive for STC to invest in a broad range of varying program types.

4. *Experimentation with new uses of radio.* Under the Communications Act of 1934, the FCC is charged with a mandate to "study new uses for radio [*i.e.*, the radio frequency spectrum], provide for experimental uses of frequencies, and generally encourage the larger and more effective use of radio in the public interest." DBS is a radio service within the meaning of this provision and one which, only a few years ago, was thought to be technologically infeasible. Today, numerous countries have active programs in various stages of development. It is clearly appropriate that the United States should endeavor to maintain its leadership position in the development of new and useful radio technologies such as DBS.

5. *Improved video service for rural areas.* DBS will advance the Communications Act's objective of making modern telecommunications services available "to all the people of the United States." Despite the wide availability of television in our society, it has been estimated that there are 1.2 million households in rural and remote locations without access to even a single television signal, and millions more that receive only one or two channels. In addition, without DBS, tens of millions would be deprived of the opportunity to receive any subscription television service.

6. *Enhanced leadership position of the United States in space technology.* The development of an American DBS system will further the key national objectives of promoting advancements in the art of satellite communications and maintaining the preeminent position of the United States in the satellite field. In addition, the technological developments which will be associated with the establishment of DBS will be useful for a wide variety of future satellite communications services.

7. *Expanded economic activity and employment opportunities in the United States.* The development of DBS will promote U.S. economic activity in a high-technology field which is important to the nation's future. While initial DBS job opportunities will be concentrated in the area of satellite design and construction, the U.S. Department of Labor estimates that a fully deployed STC system will directly or indirectly support up to 23,000 jobs in diverse fields. Furthermore, STC will establish a $1 million Minority Enterprise Small Business Investment Company to ensure that the economic benefits of the new venture will be shared by all members of the community.

Need for Expeditious Action

Substantial lead time is required to construct and launch direct broadcast satellites. STC estimates that, following FCC approval of the application, it will need approximately 39 months to place the DBS system in operation. Protracted agency proceedings could seriously compound this delay and jeopardize public enjoyment of the benefits of DBS.

Accordingly, STC has urged the FCC to expedite consideration of its proposal and grant the application prior to the termination of time-consuming rulemaking proceedings. On previous occasions, the Commission has processed experimental applications without resorting to rulemaking procedures designed to establish permanent regulatory frameworks for new services. This approach minimizes the threat that regulatory delay poses to the successful introduction of emerging technologies and permits the Commission to fulfill its statutory duty to encourage experimentation in radio communications.

Needless delay in the implementation of direct satellite broadcasting also can be avoided by placing DBS within an appropriate, established framework for substantive regulation. For example, the SSTV service proposed by STC is functionally indistinguishable from existing terrestrial subscription television services that consistently have been classified as broadcasting by the FCC and Congress. Under existing law, therefore, SSTV is properly classified as broadcasting and the processing of STC's application need not be postponed pending the establishment of a new regulatory scheme for DBS services.

Before issuing an experimental authorization, the FCC must offer the public an opportunity to comment on the issues presented and make a determination that the proposed experimentation holds promise of serving the public interest. The Commission, however, need not find that a permanent DBS system would serve the public interest nor is it required to determine how a permanent system should be regulated.

The substantial benefits of establishing a satellite-to-home subscription television service discussed above certainly constitute adequate grounds for an FCC finding that the proposed service has strong potential to serve the public interest. Moreover, there is no countervailing reason to delay the authorization of experimental DBS operations. For instance, the fact that broadcasting-satellite frequencies will not be assigned to nations in the Western Hemisphere until the 1983 Regional Administrative Radio Conference does not bar prompt FCC approval of STC's application. The direct broadcast satellites designed by STC can accommodate any reasonable outcome of the 1983 Conference, and their technical flexibility enables the FCC to authorize construction prior to 1983.

For all of these reasons, the FCC will be in a position to act quickly on the STC application as soon as the period for public comment is closed (the comment period will run within the first part of 1981). Significant policy questions concerning a permanent regulatory scheme for direct satellite broadcasting will remain unanswered at that time, but many of these cannot be addressed prior to an actual demonstration of the service in operation.

STC's experimentation with DBS will provide the FCC with the data and experience required to form sound judgments concerning the new technology and promulgate comprehensive rules and policies to govern permanent satellite broadcasting systems. For example, the results of experimentation in the field of marketing may be particularly significant in estimating demand for SSTV services and the demand information, in turn, may be critical to domestic decision-making with respect to the technical configuration of DBS systems and spectrum allocation.

It remains to be seen whether the FCC will seize its opportunity to expedite approval of the nation's pioneering direct broadcast satellite system. A decision to take swift action on STC's proposal would maximize the utility of pending and future agency proceedings and avoid unnecessary delay in extending the benefits of DBS to the American public. Hopefully, the FCC will adopt procedural and substantive policies to facilitate the early introduction of this exciting new technology.

W A T E R

measuring it via satellite

by Stephen A. Saft, Editor.
Photography by William J. Megna

What is shaping up as the world's first large-scale satellite-dependent natural resource monitoring system is moving ever closer toward completion, and Comsat General is playing an important role in helping to bring the project into existence. The natural resource being monitored in this case is that precious commodity known as water.

Once the project is completed, electronic data gathering and communications equipment installed at 327 pre-established monitoring sites adjacent to rivers, lakes and reservoirs all across the country will be transmitting water height information to either one of two U.S. Government communications satellites in geosynchronous orbit. Already many of these 327 installations have been made and are regularly gathering and transmitting water height data.

On the receiving end of the satellite transmissions is a computer at the headquarters of Environmental Research and Technology, Inc. (ERT), a Comsat subsidiary, which puts the information into usable format. The ERT computer feeds the formatted data to a computer at the Reston, Virginia headquarters of the United States Geological Survey (USGS), a bureau of the U.S. Department of the Interior. USGS in turn makes the data available to the 600 cooperating federal, state and local agencies with which it works. These organizations are known as the USGS's "cooperators." Heading the project at USGS is William G. Shope, Jr., a hydrologist whose title is Chief, Satellite Data Relay Project.

Of the 327 sites, Comsat General Corporation under the direction of Don Kutch, Program Manager, has the responsibility of assembling, testing, installing and maintaining the earth terminal equipment at 105 sites. In turn, Comsat General is making use of the staff at the regional offices of ERT for the job of installing and maintaining the equipment.

The remaining 222 installations are operated by USGS employees. In all Comsat General's contract with the USGS, which is for 18 months and ends 1982, amounts to approximately $2.2 million. The contract contains an option which if exercised would extend it another 18 months.

In terms of geography, the breakdown of the 105 sites at which Comsat General is making installations looks like this: 20 in New England, 20 in Pennsylvania, 20 in Colorado, 15 in Arizona, and 30 in Texas. Another member of the Comsat family in addition to Comsat General and ERT is participating in the project, incidentally. Comsat General TeleSystems, Inc., located in Fairfax, Virginia, has the responsibility of testing all earth terminal equipment before it goes out into the field.

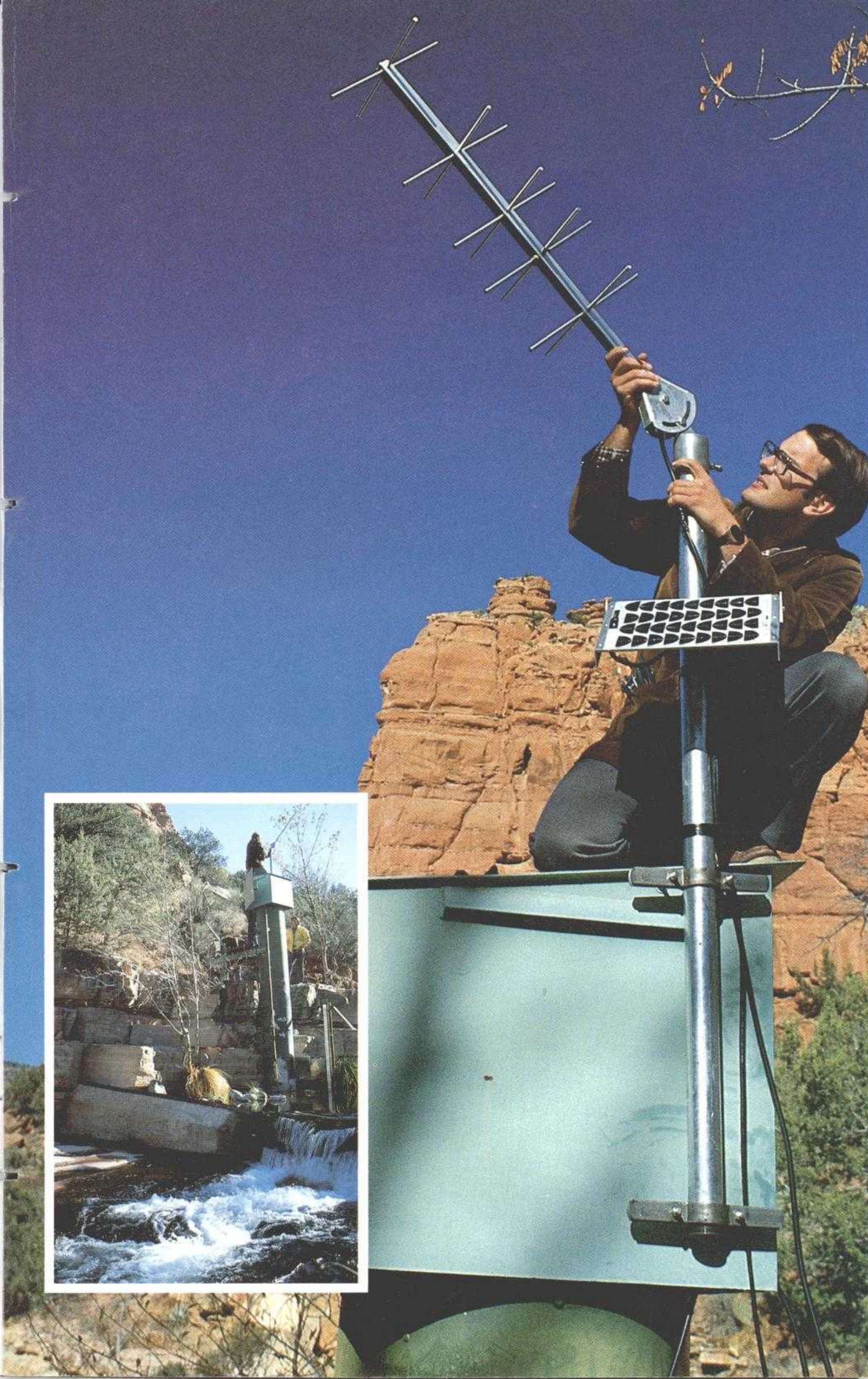
The satellites being used for relaying the water height data from the earth-terminal-equipped sites are owned by the U.S. Government and are the responsibility of the National Oceanic and Atmospheric Administration (NOAA) and its National Earth Satellite Service (NESS). NOAA is an agency of the Department of Commerce. The satellites are called GOES for Geostationary Operational Environmental Satellite.

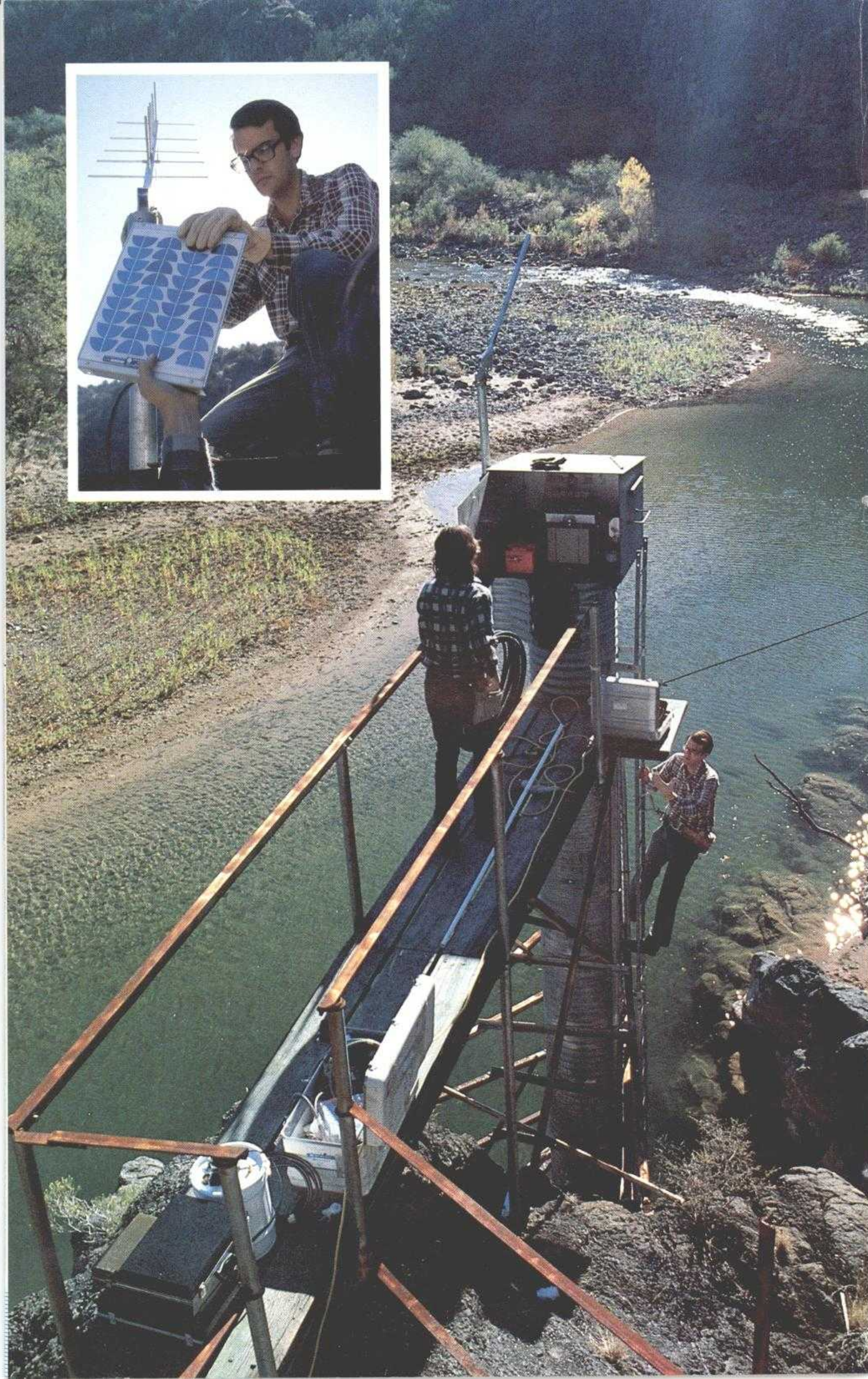
It is perhaps too early to make any final judgments about the effort, but it is fair to assume that it would not have been undertaken in the first place if its proponents at USGS and its cooperating organizations were not close to being convinced that in terms of cost, speed, usefulness and reliability it is the preferred method of collecting water quantity data.

At the present time, USGS in conjunction with its cooperators operates a total of about 9,000 hydrologic data collection stations around the country. These stations, many of them located in remote areas separated from civilization by many miles of difficult terrain, are visited with a frequency that varies from one to six weeks.

Continued page 35

Comsat General's Larry S. Burch aims crossed Yagi antenna for operation with one of GOES satellites at USGS water monitoring site at Wet Beaver Creek near Rim Rock, Arizona, 75 miles north of Phoenix. Inset shows position of measured water column pipe or "well" in creek.





An employee of USGS or a cooperating organization hikes, takes four-wheel-drive vehicle or helicopter to the station, enters it, and either writes down the information shown or collects the paper tape from the water height recorder inside. After he reaches civilization, the data is then transmitted to Reston over phone lines.

As a result of such a process as this, USGS is able to provide an annual assessment of the nation's water resources. It is a good system, but it is not always 100 percent reliable. A collection station paper tape recorder can break within moments of being visited by a technician and then fail to record any information until it is fixed during the next visit of the technician a month later.

In addition, because the system depends on personal visits to achieve data collection, it is not an inexpensive activity, and given inflation, meaning salary and benefit increases and sky-rocketing fuel prices in this case, we need be no seer to predict that the cost will continue to rise significantly each year. Finally, the system is far too slow to be useful for such important activities as flash flood forecasting.

Reliability, reduced cost, speed and greater usefulness are the expected benefits from USGS's satellite data relay project. Should a satellite-linked earth-terminal-equipped monitoring station fail, the USGS and its cooperators will know about it in a matter of hours, not weeks. And, except when stations fail to transmit meaningful data, visits to them can be limited to infrequent calls for preventive maintenance or for re-confirmation of transmitted data.

Perhaps most exciting, the project holds the promise that on a near-real-time basis—that is, almost instantly—the USGS, a cooperator or anyone else for that matter who needs the information can know the status of the water resources of a region. And the value of the system as an instant water inventory is hardly the only example of its usefulness.

Is a flood coming? Are drought conditions continuing? Operators of dams, hydroelectric plants, municipal water supplies and irrigation systems and police and civil defense authorities want to have such information as well in advance of a likely crisis as possible. Through early warning, they can sometimes avoid the crisis entirely. At the very least, they can reduce its most devastating effects.

In Arizona, for example, probably the most advanced version of the satellite data relay project is being implemented. Recently, William J. Megna, **Comsat Magazine**'s principal photographer, travelled with a team led by Larry S. Burch, Senior Equipment Engineer, **Comsat General**, and members of USGS's Arizona District staff, as they installed two water height monitoring earth terminals over a two-day period in remote areas of Arizona. Also on the expedition were two employees of Western Scientific Services, Inc., an **ERT** subsidiary in Fort Collins, Colorado—Kris Johnson and Robert Layman.

On the first day, with the help of USGS's Frank C. Brewsaugh, the team installed an earth terminal at a monitoring station on Wet Beaver Creek, near Rim Rock, Arizona, about 75 miles north of Phoenix. The second day a terminal was installed at a monitoring site on the East Verde River, near Childs, about 55 miles north of Phoenix. The USGS's Jack Blee helped direct the team in this effort. To reach the first site, the team had to travel for several miles by four-wheel drive vehicle on an almost nonexistent road. To reach the second site, the only practical form of transportation was a helicopter, provided by the Salt River Project, a public utility delivering both water and power in the greater Phoenix area. In both cases, the team had to do some hiking to get to the site, and in one case rock climbing was required.

Both Wet Beaver Creek and the East Verde River are major tributaries of the Verde River, which in turn empties into the Salt River, the major waterway running through the city of Phoenix.

Installed at the four pre-established monitoring sites were the five major pieces of equipment that make up a

View of monitoring site on East Verde River near Childs, Arizona, where Comsat General has also installed equipment for relaying water height information via satellite. Inset: Comsat General's Larry S. Burch installs solar module.

water height monitoring earth terminal—an analog to digital recorder (ADR), a data collection platform (DCP), a battery pack, a solar module and a 400-megahertz crossed Yagi antenna. The ADR converts the movement of a float up and down a vertical pipe—called a "well"—into digital information. The information is delivered to and stored in the DCP for transmission by means of the antenna in precisely timed bursts once every three hours.

The role of the solar panel is to keep the battery charged. It is the battery that powers both ADR and DCP.

Comsat General is putting in 15 water height earth terminals at sites that have a history of usefulness for water-height monitoring in the State of Arizona. Another 43 are being installed by the State of Arizona in cooperation with the USGS. Altogether, the 58 terminals will form a very sophisticated water resources monitoring system that will include both drought and flood warning as central features.

The functioning of USGS's satellite data relay project in the State of Arizona was described to this writer by Dr. Robert MacNish, Chief, Arizona District, USGS Water Resources Division. Faced normally with tight water supplies, Arizonians also have experienced more than their fair share of floods. The city of Phoenix, for example, has been hit by floods ranging from mild to severe every year since 1977. To lessen the effects of such climatic extremes, the people who control the floodgates on the state's many dams need accurate information on the rate of runoff from the mountains into the tributaries of its rivers, and they need that information quickly.

An especially dangerous situation exists when warm rain falls on mountains packed with snow. Water from melting snow and rainfall gushes into creeks and streams swelling them to well above normal levels. The water then surges into the rivers.

Eventually, the excess water will pour in churning torrents into the state's dam-created reservoirs. If the water pouring into the reservoirs exceeds their capacity by a considerable amount, the water will wash over the tops of the dams, possibly damaging them structurally and inevitably causing major flooding on the banks below.

Warned well enough in advance and given some idea how much water to expect, dam managers can begin releasing reservoir water to make room for the new supply. If the water release can take place early enough, flooding can be avoided in all but the most extreme cases.

To enhance its flood warning capability, the DCPs in the earth terminals installed in Arizona have high limits programmed into them. Should these unusually high flows be exceeded, the DCPs are programmed to begin transmitting their data immediately. They do not wait for their normal every-three-hour burst transmission slot.

USGS's cooperators in the State of Arizona such as the Arizona Department of Water Resources and the Salt River Project, to name but a couple, are already receiving data collected at the terminals in their state directly. They are also being aided in their drought and flood forecasting efforts by the River Forecast Center of the National Weather Service in Salt Lake City, Utah, which also has a branch office at Sky Harbor Airport in Phoenix. Interestingly, the River Forecast Center is one of the major users of the data generated by the USGS satellite data relay project.

What USGS, Comsat General and the USGS cooperators are doing in bringing the satellite data relay project into being could signal a boon for people everywhere. Floods yearly take hundreds of lives and do untold damage to property around the world. The effects of drought are less dramatic, but in the end even more pernicious. Controlling these scourges is work worthy of pride. From the technological perspective, the work is no less important, for it is helping to broaden still further the uses of a technology—namely satellite communications—that has already done so much for so many all over the world.

Intelsat Board reduces rates

For the twelfth successive year, the Intelsat Board of Governors reduced space segment rates. The action, taken at the Board's December 1980 meeting, became effective January 1, 1981. The monthly rate for one half of a two-way telephone circuit (termed the rate per unit of utilization) now becomes $390, reduced from $420. The Board also agreed to reduce the rates for its other services. The charge for a SPADE circuit, which is a channel assigned on an "on demand as needed," rather than a permanent basis, was reduced from 6 cents to 5.5 cents per minute. For the first time since 1968, the Board also authorized a reduction in the tariff for international television transmission to $8 per minute, reduced from $8.75. The charge for capacity used to restore submarine cables was also reduced, from $31 to $28 per unit per day.

The Board also established a new service offering for a one-way, leased, full-time international television channel, using space segment capacity on spare satellites, for a minimum period of five years. This service was established at the request of Australia, where there is interest in receiving large amounts of U.S. television programming. A lease agreement for the service would be signed by both the United States and Australia.

ERT helps group with report

ERT, a subsidiary of Comsat based in Concord, Massachusetts, played a major role in preparing a report on key air quality issues recently released in Washington by The Business Roundtable. Composed of chief executives of 200 of the largest corporations in the United States, The Business Roundtable retains ERT as its principal advisor on air quality issues.

Dr. James R. Mahoney, ERT Senior Vice President, took part in the press conference as well as the EPA and Congressional briefings organized by The Roundtable. ERT had worked with The Roundtable to define the issues to be analyzed and was responsible for examining air quality permitting procedures for The Roundtable's report.

The Business Roundtable was founded in 1972 to examine public issues which affect the Nation's economy and to develop positions on these issues which seek to reflect sound economic policy.

SBS asks to serve Canada

Satellite Business Systems (SBS) has applied for authority to provide private communications services between designated points in Canada and the United States. SBS is headquartered in McLean, Virginia, and is a partnership sponsored by Aetna Life & Casualty, Comsat General Corporation, and IBM. Its first satellite was launched successfully on November 15, and operational system service is scheduled to begin in the first quarter of 1981.

The Canadian extension of SBS services and their interconnection with Canadian carriers would be the world's first transborder availability of advanced digital satellite communications services.

Implementation would require approval by the Federal Communications Commission as well as policy agreement between the two governments and operating agreements among SBS and Canadian communications carriers.

The contemplated Canadian locations for SBS service lie within the authorized footprint of the SBS satellite. Interconnection between the United States and these Canadian locations directly through the SBS satellite is both technically feasible and operationally efficient.

SBS has advised the FCC that five of its customers have expressed interest in interconnection of their SBS networks in the United States with their branches or affiliates in Canada.

The five are General Motors Corporation, ISA Communications Services, Inc., The Travelers Insurance Companies, Wells Fargo & Company, and Westinghouse Corporation. Additional specific requests are expected.

Continued next page

The Canadian locations to which customers seek SBS service to date include Hamilton, Ontario; Montreal, Quebec; Oshawa, Ontario; Toronto, Ontario; and Vancouver, British Columbia.

The services to be provided, beginning as early as the fourth quarter of 1981, would be part of SBS's Communications Network Service for customers. This is an advanced, all-digital high-capacity private telecommunications network providng voice, data, electronic mail, and video teleconferencing transmissions.

In the application to the FCC, SBS stated its belief that the requested authority would be consistent with the Communications Act of 1934, the Intelsat (International Telecommunications Satellite Organization) agreements to which the United States is a signatory, and the 1972 U.S.-Canadian Intergovernmental Agreement which permits the transborder use of domestic satellite systems of either country for transmissions "incidental and peripheral" to the provision of domestic services. SBS would also support modification of that Agreement which would further encourage the transborder use of U.S. and Canadian satellite systems and which would provide a more comprehensive policy framework for the exchange of such services.

SBS will be prepared, if authorized by the FCC, to work out non-exclusive but reciprocal arrangements for the reception and distribution to specified points in the United States of Canadian private line services conveyed via Canadian Anik satellites operating in the 12 and 14 GHz bands.

Comsat General acquires Compact Engineering

Comsat General Corporation has acquired by merger Compact Engineering, Inc., a Palo Alto, California, firm engaged in the development and sale of computer-aided design software for electronic circuit design. The company serves about 300 companies worldwide.

Compact Engineering was acquired for 35,714 shares of Comsat common stock to enhance Comsat General's entry into computer-aided design and manufacturing (CAD/CAM).

Les Besser, former President of Compact Engineering, will continue to direct its operations and assumes the position of Senior Vice President, Comsat General Integrated Systems, a newly-formed subsidiary of Comsat General based in Palo Alto that is pursuing various manufacturing and integrated design and manufacturing system sales opportunities.

Three Intelsat V-As ordered

Three increased capacity Intelsat V-A satellites were procured by the Intelsat Board of Governors at its most recent meeting last December in Washington, D.C. The spacecraft, which will be utilized beginning in 1984, will have a capacity of up to 15,000 circuits (as compared to the 12,000 circuit Intelsat V), and will include two high powered, steerable spot beams tailored for provisions of domestic services. The Board also authorized initiation of long-lead effort for up to three additional Intelsat V-As; a decision concerning the total number of spacecraft and their configuration will be made at a later date. The Board's action culminated over a year of study, which indicated that at least three Intelsat V-As will be required to meet increasing traffic demand and to provide operational flexibility. The need for further spacecraft continues to be examined. The Intelsat V-A will be manufactured by Ford Aerospace and Communications Corp., under an amendment to the contract for the original Intelsat Vs.

Significant work has been accomplished on an RFP for the Intelsat VI series of spacecraft; the Board intends to complete its review of this program and authorize release of the RFP in March 1981.

World Systems assignments made

Key staff appointments have now been made to the new Comsat World Systems Division by Dr. John L. McLucas, President. Formed September 1980, the new division enhances the Corporation's ability to focus on its unique responsibilities in developing and improving world communications via satellite and is made up of the following units: International Communications Services, Comsat Laboratories, Intelsat Technical Services and four staff functions. The staff functions are Legal, Contracts and Procurement, Personnel and Finance.

Irving Goldstein has been elected Senior Vice President of Comsat and is in charge of International Communications Services, which includes Comsat's international services via the Intelsat System as well as provision of commercial maritime satellite services through the Inmarsat System. Mr. Goldstein is also Chairman of the Intelsat Board of Governors and Chairman of the U.S. Earth Station Owners Committee.

Dr. John V. Harrington is Senior Vice President, Research and Development, and Director of Comsat Laboratories. Dr. Harrington has overall corporate responsibility for research and development. Comsat Laboratories, under Dr. Harrington, will maintain its prime mission to ensure United States leadership in satellite communications technology through Comsat's role in Intelsat and Inmarsat and will continue to carry on research activities in support of other Corporate operations.

Louis Pollack is Vice President, Intelsat Technical Services (I.T.S.). I.T.S. is responsible for providing a broad range of technical services to Intelsat including monitoring of the design, construction and test of Intelsat satellites, design of future satellite systems, and operation of the Launch Control Center and in-orbit services related to operational satellites.

The four World Systems Division staff functions are headed respectively by Lawrence M. DeVore, Vice President & General Counsel; Lewis C. Meyer, Vice President, Contracts and Procurement; William Callaway, Acting Division Controller, and Robert A. Dahlgren, Manager, Personnel.

International Communications Services Organization

Reporting to Irving Goldstein, Senior Vice President, International Communications Services, are four vice presidents with responsibility for these functions: Operations, Project Management and Development, Marketing, and Maritime Services.

Joel R. Alper is Vice President, Operations. Mr. Alper is responsible for U.S. Systems Operations as well as operation of the U.S. earth stations located in Maine, West Virginia, Washington, California, Hawaii, American Samoa and Saipan. Mr. Alper is also responsible for Space Segment Engineering and Analyses and the Intelsat Representation functions. He is an alternate U.S. Governor to the Board of Governors and performs the function of Governor during Mr. Goldstein's chairmanship.

Robert W. Kinzie is Vice President, Project Management and Development. Mr. Kinzie is responsible for project management and ground segment engineering for Comsat and ESOC Ground segment construction. Mr. Kinzie is also responsible for the Comsat Maintenance and Supply Center, finance and data systems. He is the U.S. representative to the Budget and Accounts Review Committee of Intelsat.

George A. Lawler is Vice President, Marketing. Mr. Lawler is responsible for International Communications Services marketing activities. In addition, he has been given responsibility for direct TV services to Comsat customers as well as operation of the Service Bureau and Communications Center.

Edward J. Martin is Vice President, Maritime Services (formerly called the Inmarsat Division). The Marisat Operations group has recently been transferred from Comsat General Corporation to Maritime Services. Mr. Martin is also Comsat's representative on the Inmarsat Council.

N O T E S

Key Comsat General positions filled

Three key positions within the Comsat General Corporation organization were recently filled.

Bruce D. Smith has been elected Vice President, Planning and New Ventures. Before joining Comsat General, Mr. Smith was Chairman of Chat (Telecommunications) Corporation and President and Chairman of Allied Water Corporation.

Robert D. Briskman has been named Assistant Vice President, Systems Implementation, reporting to Burton I. Edelson, Senior Vice President of Systems Technology Services. Mr. Briskman came to Comsat from the National Aeronautics and Space Administration in 1964 and was placed in charge of satellite command and control activities for Early Bird, the first commercial communications satellite.

William P. Osborne has joined Comsat General TeleSystems, Inc., as Vice President of Engineering. Dr. Osborne was Director, Equipment Integration Division for Comsat Laboratories and before that Director of Component and Product Development also at Comsat Labs. Before joining Comsat, he spent nine years at the Harris Corporation.

Intelsat appoints Deputy Director General

Intelsat has appointed Francis Latapie as its new Deputy Director General, Administration, replacing Andrea Caruso, who recently retired. Mr. Latapie, a French citizen, is currently Director of Procurement at Intelsat.

Intelsat (the International Telecommunications Satellite Organization) is the 105-member-country organization that owns and operates the global satellite communications system that currently carries about two-thirds of the world's international overseas telephone calls. Headquarters for Intelsat is in Washington, D.C.

Officers elected to new positions

Five officers of Comsat have been elected to new positions by the Board of Directors.

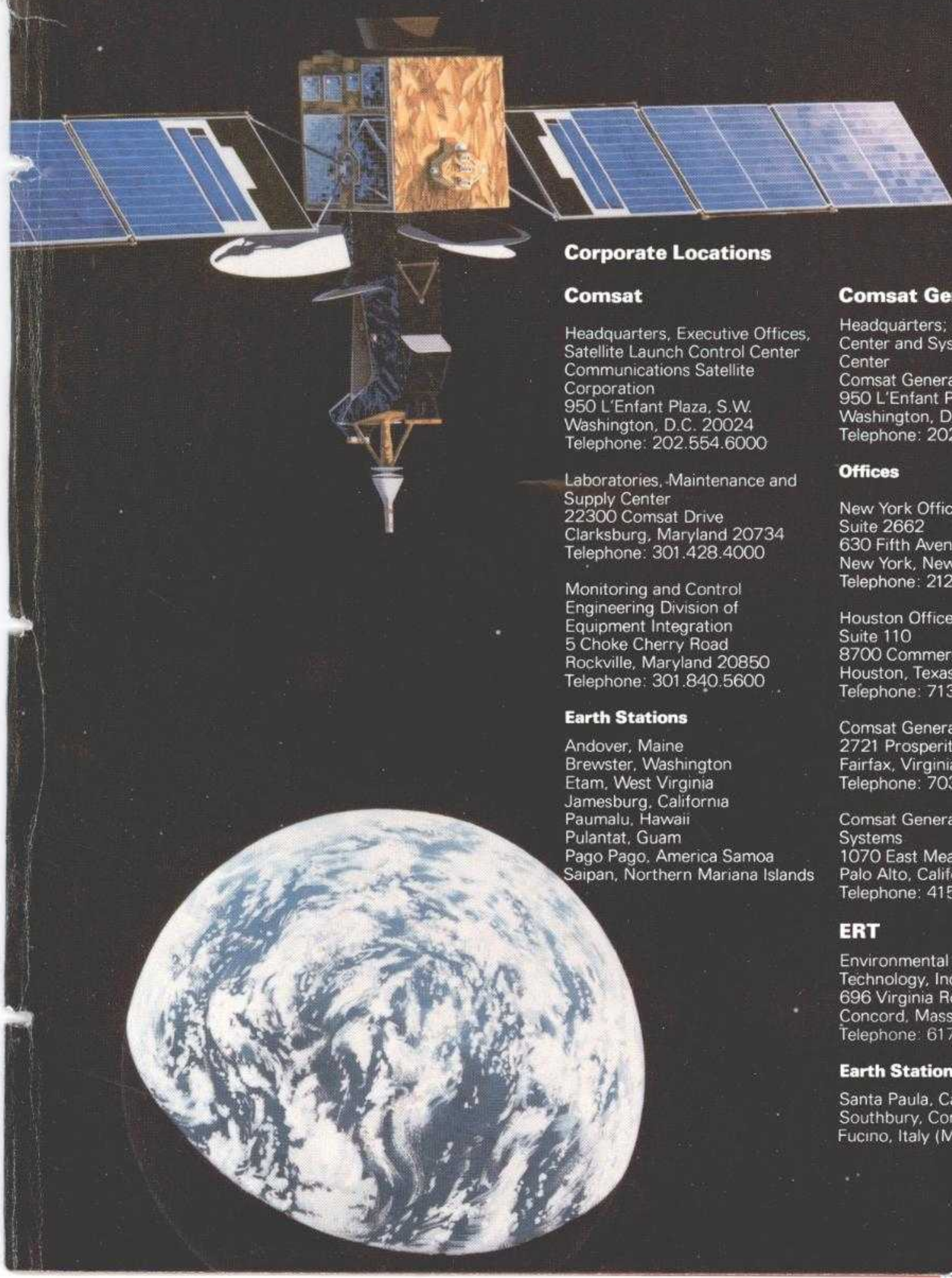
Carl J. Reber has been elected Senior Vice President, Finance. Mr. Reber, Comsat's chief financial officer, was formerly Vice President, Finance. He joined the Corporation in 1964. Before assuming broader financial responsibilities in 1975, he was responsible for Intelsat financial matters in Comsat's earlier role as manager for Intelsat.

William H. Berman has been elected Senior Vice President and General Counsel. Previously, Mr. Berman had served as Vice President and General Counsel. Before joining Comsat in 1964, he served as Deputy General Counsel, U.S. Arms Control and Disarmament Agency.

Donald E. Greer has been elected Vice President, General Services. Previously, he was Assistant Vice President, General Services and Headquarters Executive Officer. Mr. Greer joined Comsat in 1964 as Special Assistant to the President after retiring from the United States Air Force.

Sidney Metzger has been elected Vice President and Chief Scientist. Formerly Assistant Vice President and Chief Scientist, Mr. Metzger has been with the Corporation since 1963. Earlier in his career, Mr. Metzger was in charge of the Communications Engineering Department of RCA's Astro Electronics Division and was responsible for the communications engineering on the early satellites SCORE, TIROS and RELAY.

David S. Nye has been elected Vice President, Personnel. Mr. Nye had been Assistant Vice President, Personnel. Following 15 years with Mobil Corporation in various personnel positions, Mr. Nye joined Comsat in 1973 as Director of Personnel.



Corporate Locations

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Etam, West Virginia
Jamesburg, California
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Pulantat, Guam
Pago Pago, America Samoa
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Earth Stations

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Fucino, Italy (MARISAT TTC&M)

Communications Satellite
Corporation

COMSAT