COMMUNICATIONS VIA SATELLITE – DIVIDEND OF THE SPACE AGE

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Last June my daughter graduated from college, and like all proud fathers, I attended the graduation. On the way down I spent an hour or two at the Hermitage ... Andrew Jackson's home in Tennessee. One of the things that interested me was his carriage. This was the one he used to travel from Nashville to Washington, and the sign on it indicated that he considered the travel time between these two cities to average 21 days.

It is difficult to realize but if you stop and think you will conclude that in all the years, from the beginning of the world until Jackson's time, and, in fact, almost until the start of the century, man's traveling speed was tied to the speed of a horse – about 15 mph. Then, suddenly, with the coming of trains and automobiles, speeds went up to 25, then 40, then 70 mph. Next came the commercial airplane, and man's speed was again increased, starting at about 100 mph and progressing to slightly subsonic (700 mph). Soon commercial supersonic aircraft will be in the skies of the world; meantime, we have the space age. Sitting in your living rooms last summer, you saw an event that required speeds in excess of 23 000 mph to be achieved. Man made a round trip to the moon, 480 000 miles, achieved useful work, and returned all within a period of 10 days. This has been a transportation revolution.

Now, fortunately or unfortunately, not many people will ever travel at those speeds, but then there are other revolutions in which we are presently participating and still others yet to come.

Up in Washington we have a television commercial advertising bread. They draw your attention back to granny's kitchen and the old coal stove and the smell of baking bread and pie. Most of us at the Congress remember all that, but I also remember the day when our first telephone was installed. I was in grammar school, so it was not all that long ago! When this telephone was installed, my home immediately had the capability to communicate with every other telephone subscriber in the city, the state, and the country. Now, that does not say we used this capability. In fact, I remember when the telephone first started to ring — and, by the way, we all knew who it was – my aunt who lived 10 miles away — the whole house panicked. Speaking of panic, do you remember the expressions on the faces of the family receiving a telegram? It sometimes took a matter of minutes before someone had the courage to open it . . . because you knew it contained important and, sometimes, bad news. You also knew that the message had been tapped out, letter by letter, on a telegraph key, and that it had been delivered to your home from the local telegraph office by a boy on a bicycle, at a delivery speed of about 10 mph.

Well, today we are having a communications revolution. The moon landing we talked about earlier came to you "live – via satellite," and you saw that event happen with only about a 2-sec delay. That delay was in the time it took the signal to come 240 000 miles from the moon to earth, be retransmitted through a least two satellite channels, the satellites being in orbit 22 300 miles above the earth, and over approximately 10 000 miles of telephone and microwave communication link. Figures 1 through 3 show the actual setup of how the sound and picture got into your living room.

The International Telecommunications Satellite Consortium (INTELSAT IV) satellite (Fig. 4) is now being used over the Atlantic and soon to be launched in orbit over the Pacific and Indian Oceans. We have satellites over all three oceans now, but those over the Pacific and Indian Oceans are smaller and of an earlier vintage, commensurate with the requirements of those areas. The INTELSAT IV satellites weigh 3058 lb at launch. They are almost 8 ft in diameter and over 17 ft tall, and have a 9000-circuit capacity for communications, or 12 color television channels. The satellite is solar-powered and has a design life expectancy of 7 years.

The space booster (Fig. 5) is used to give the satellite a maximum speed of 23 600 mph in order to start it into synchronous orbit. The synchronous orbit means that the satellite remains motionless relative to a point on earth over which it is placed.

In other words, the satellite moves at a speed which keeps it positioned directly above a particular point on earth as the earth revolves. The Atlas Centaur launch vehicle is, of course, a development of the space age. The launch vehicle is provided by NASA, and we pay NASA at a rate determined by them for this hardware and a pro rata share of launch service cost. All the risk belongs to the Commercial Satellite (COMSAT). We pay whether the launch is successful or not!

The Causey earth station, Puerto Rico, in Figure 6 (showing antenna), the Bartlett earth station in Talkeetna, Alaska (Fig. 7), and the Paumaula earth station in Hawaii (Fig. 8) are among the largest earth stations in the total earth station complex that serves the international system. They have the capability of two-way communications.

Today there are 48 earth station sites around the world with 56 antennas in 35 countries and more earth stations are joining, literally monthly, as they are completed and join commercial operations. They will grow to 82 earth stations and 108 antennas in 63 countries by 1972.

The present international system with satellites over the Atlantic, Pacific, and Indian Oceans is shown in Figure 9. Notice that although the cable system provides point-to-point communication, the satellite services whole areas, requiring only that an earth station be provided to give access to all points within the system. The INTELSAT system satellite paths and regional coverage are shown in Figure 10. The U.S. earth stations' satellite coverage is shown in Figure 11.

I do not mean this report to be self-serving, but I feel that a few words about the international consortium, of which COMSAT is the manager, might be enlightening. The Congress, with the passage of the Communications Satellite Act of 1962, established COMSAT as a private corporation, sponsored in the United Nations by the U.S. to bring to the world the benefits of our space technology. INTELSAT (Fig. 12) presently consists of 82 nations (Fig. 13).

It is a joint venture which provides for the ownership of the satellite system on an investment-use basis. Investment-use means that each member invests in the system in proportion to its anticipated use and shares in the same proportion in any revenues generated by the system. As you would expect, the U.S., having the largest communication requirement, has also the largest investment, while smaller nations invest in proportion to their need. COMSAT represents the U.S. in INTELSAT and also manages and operates the system under contract to INTELSAT. COMSAT's revenues from international satellite communications last year were almost $70 million or a net income of $17.5 million, which works out to $1.75 a share. The important point I want to leave with you from all this is that COMSAT is a private corporation, not a government agency, and no taxpayer's money went into its establishment (Figs. 14-18).

In addition to its international interest, COMSAT has before the Federal Communications Commission (FCC) an application to provide a satellite system over the U.S. (Fig. 19). As you can see from this slide, three satellites would be emplaced over the U.S. and would provide coverage of Alaska, Hawaii, Puerto Rico, and the other 48 states. Earth stations, at least for the first go round, would be established in accordance with Figure 20.

The total cost of this system, including satellites, earth stations, etc., would run in the neighborhood of $250 million. Again, COMSAT would undertake this job without government support, using only those moneys available to any private enterprise.

Finally, as you may have heard, there exists now a requirement for an aeronautical satellite to provide better communications over the Atlantic and over the Pacific between airplanes and their ground controllers, and also eventually, airplane-to-airplan communication (Fig. 21). This program has been under consideration by COMSAT for several years. As you would expect, there exists a necessity to bring together a number of commercial companies (the airlines), the government (Federal Aviation Administration [FAA], FCC, Office of Telecommunications Policy [OTP], Department of Transportation [DOT], Department of State, etc.), and their European counterparts.

Today, our theme is to try to show that there are, in fact, desirable spin-offs from the space effort. Needless to say, the entire communications satellite system, beginning with the launch vehicle which gives the satellite the necessary speed to put it into orbit; the computers which calculate trajectories, duration, and amount of thrust, etc.; the satellite itself from its solar cells and its standby batteries; its exotic despin motor; and so forth, are all spin-offs of the space age. None of these would be available without the tremendous effort made over the past decade to place man on the moon. It is heartening to me to note that this entire sophisticated system has already paid back in some small measure in that it allowed you, the taxpayer, to watch men land, work, and walk on the surface of the moon. Much greater dividends are on the way.

Communications are growing at a tremendous rate. We program into all our planning 15 to 30 percent growth per year. It is my earnest hope that as we progress, we will succeed in bringing the world not only better communications, but better mutual understanding and solutions to worldwide problems (Fig. 22).

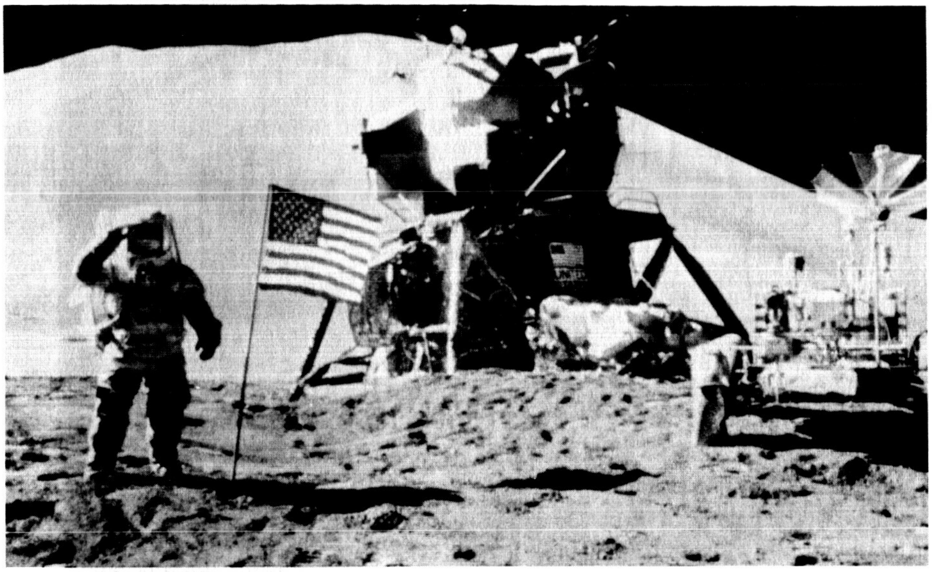

Figure 1. Apollo XV Astronaut Irwin saluting the flag.

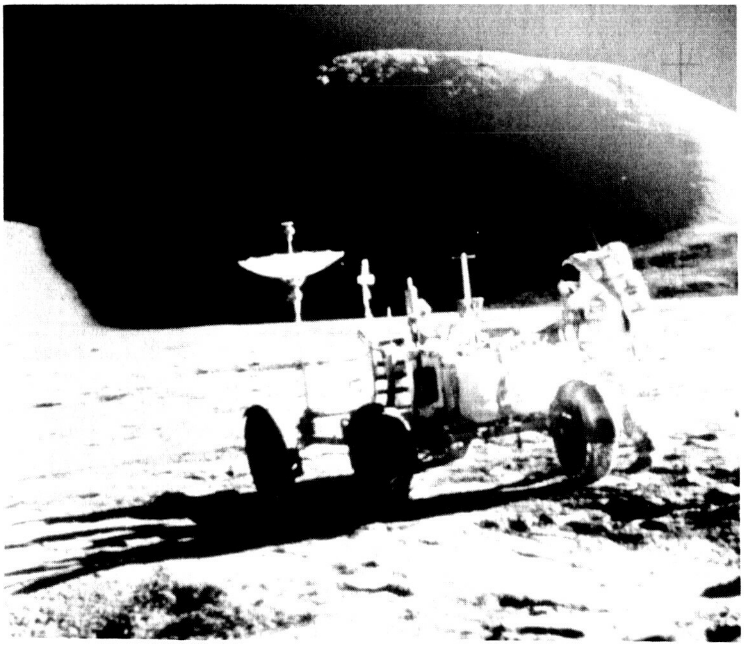

Figure 2. Apollo XV crew on Rover.

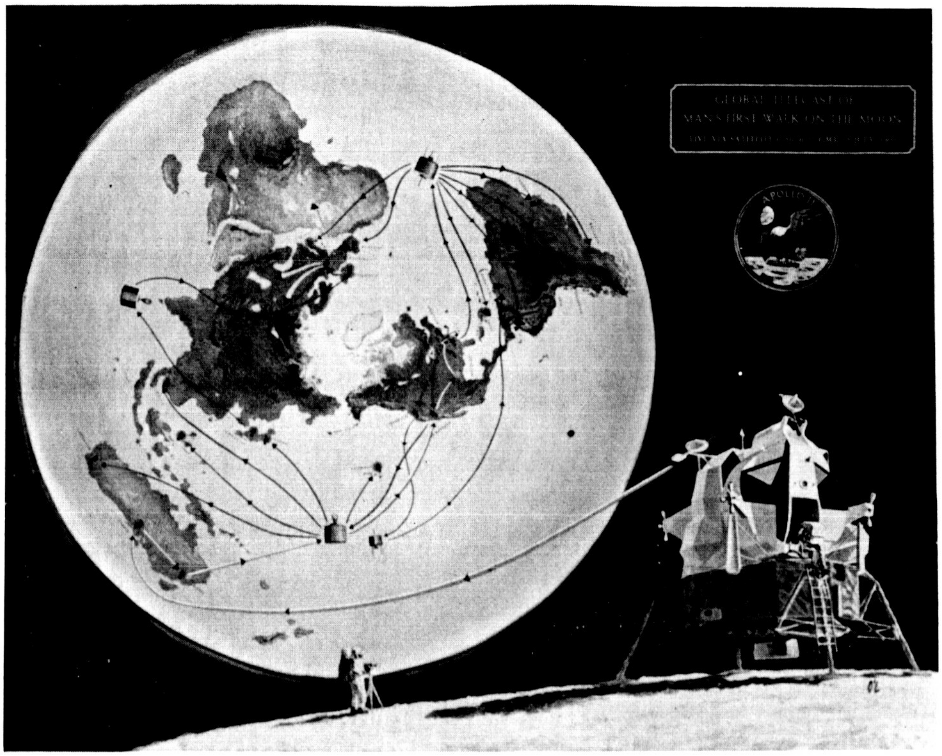

Figure 3. Global telecast, Apollo IX.

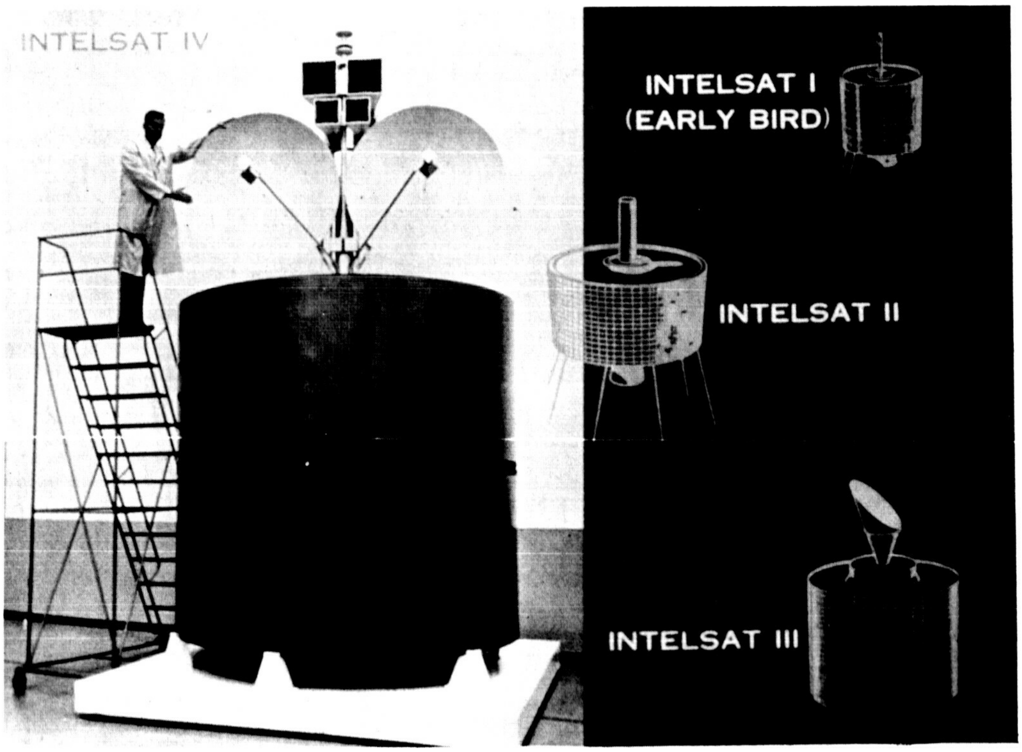

Figure 4. INTELSAT-IV at Hughes with technicians on ladder.

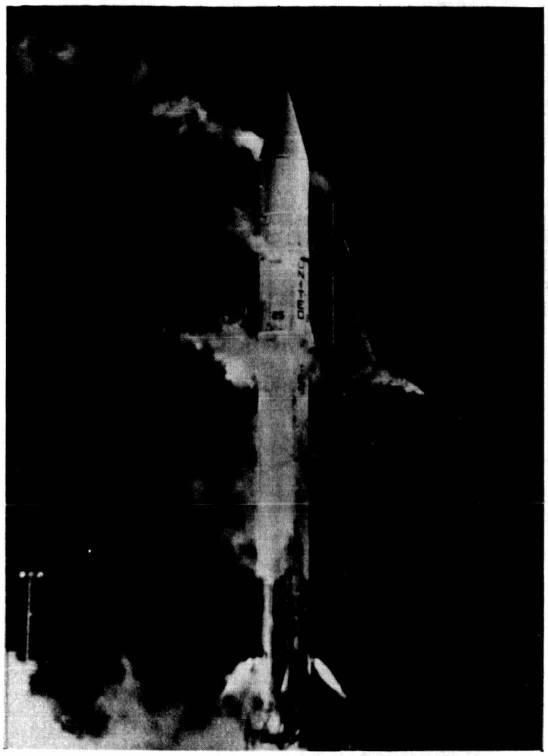

Figure 5. Launch of INTELSAT IV (F-2); Atlas/Centaur Launch Vehicle.

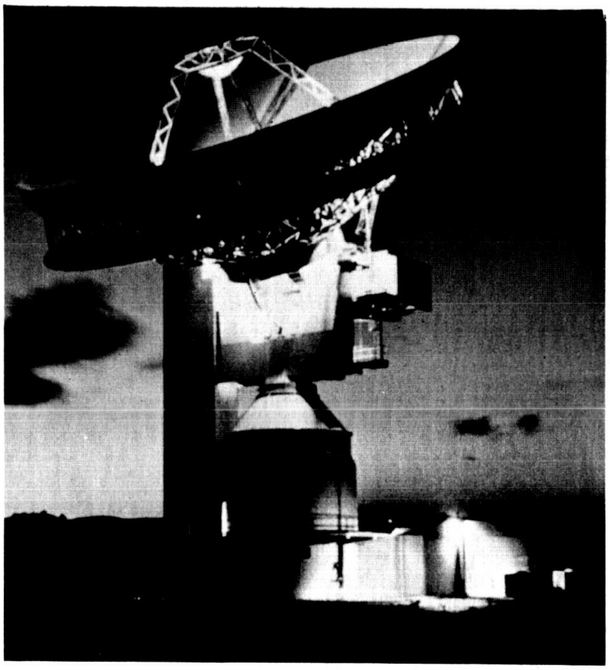

Figure 6. Causey earth station antenna.

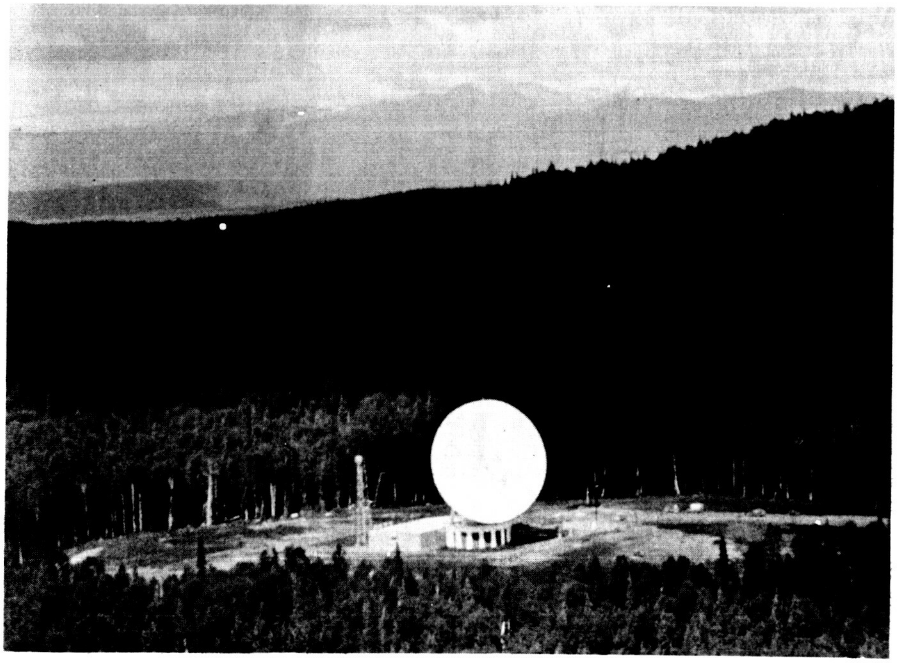

Figure 7. Bartlett earth station aerial view.

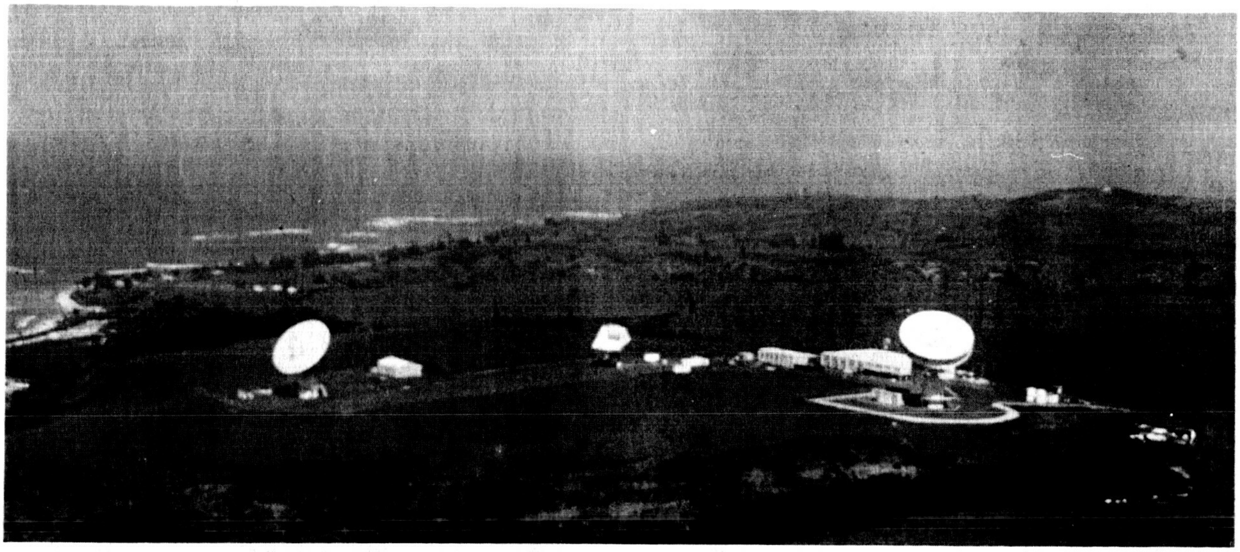

Figure 8. Paumaulua earth station aerial view 1.

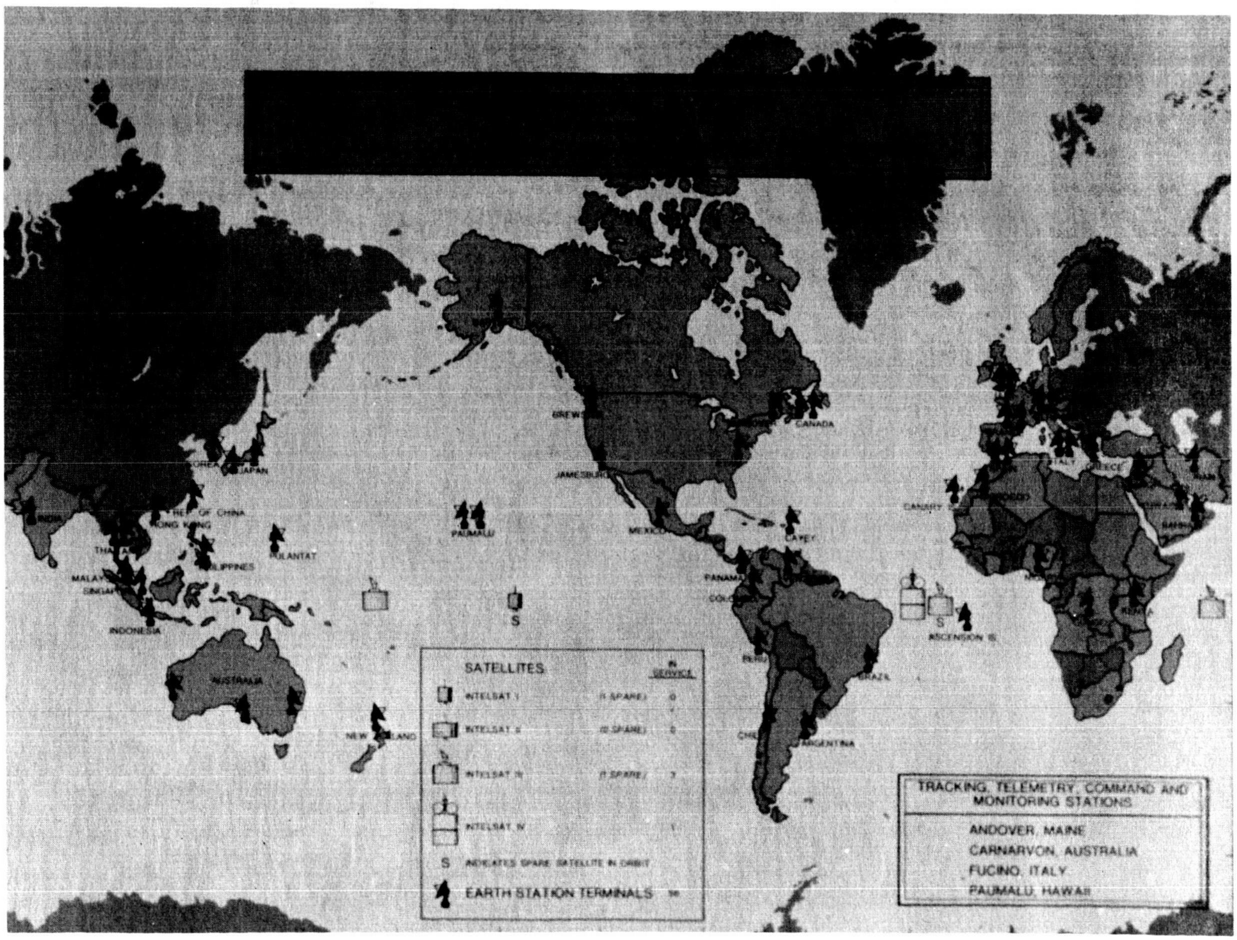

Figure 9. The INTELSAT System.

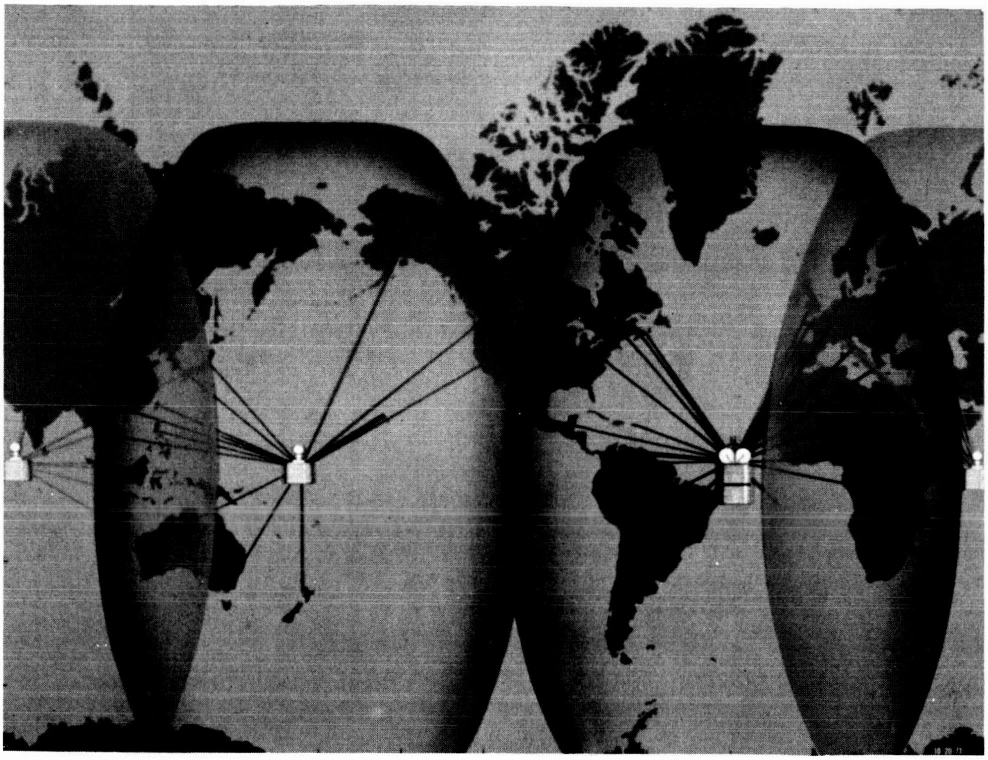

Figure 10. INTELSAT System satellite paths and coverage by region.

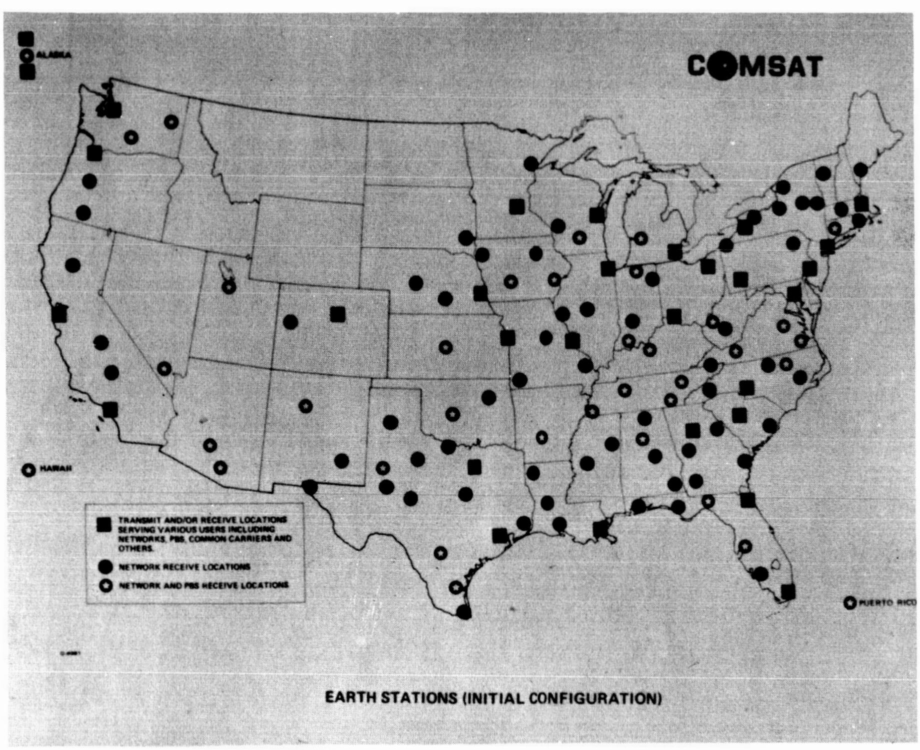

Figure 11. U.S. earth stations (on topographical map with U.S. borders).

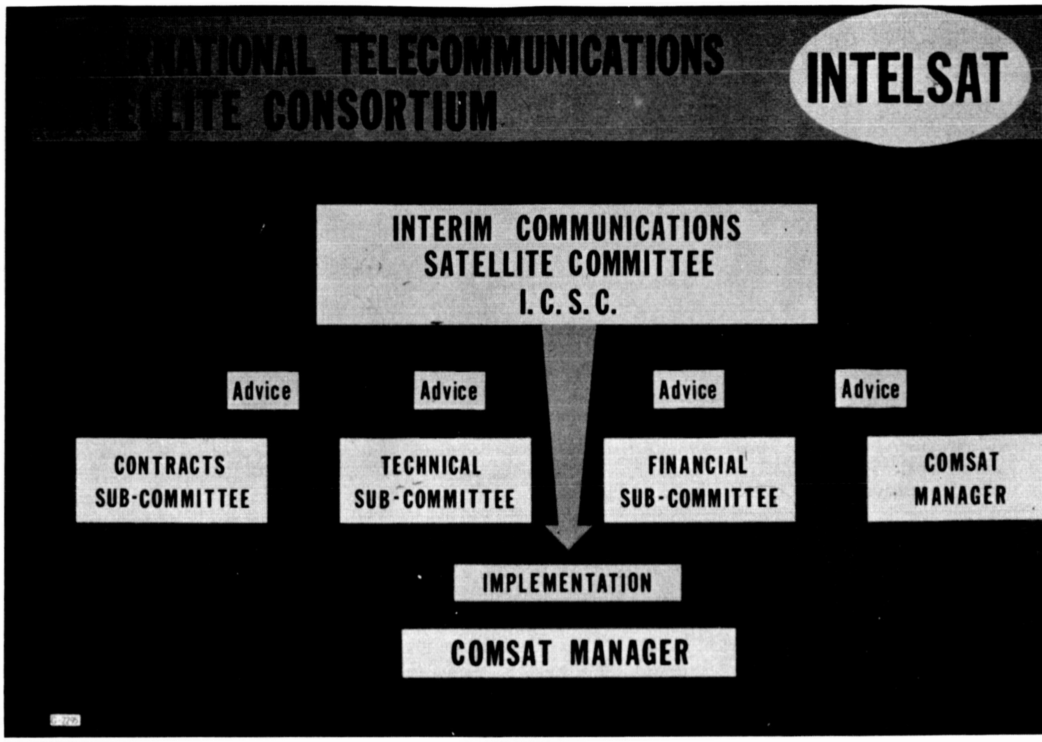

Figure 12. Organization of INTELSAT.

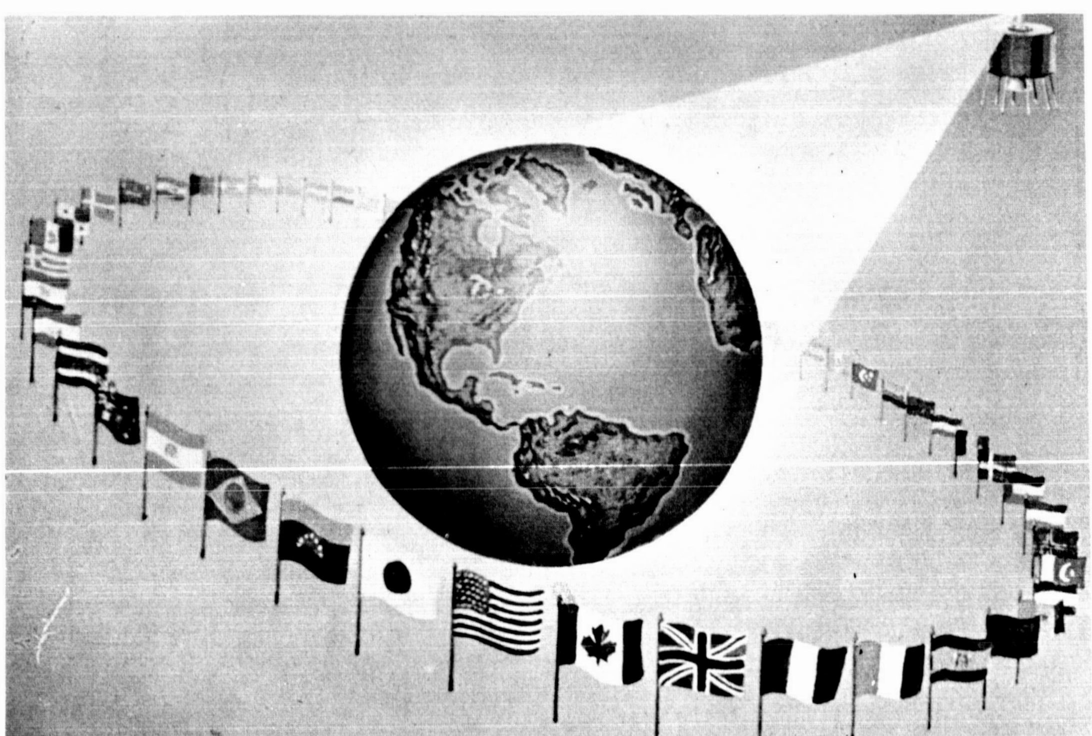

Figure 13. Flags of INTELSAT member nations.

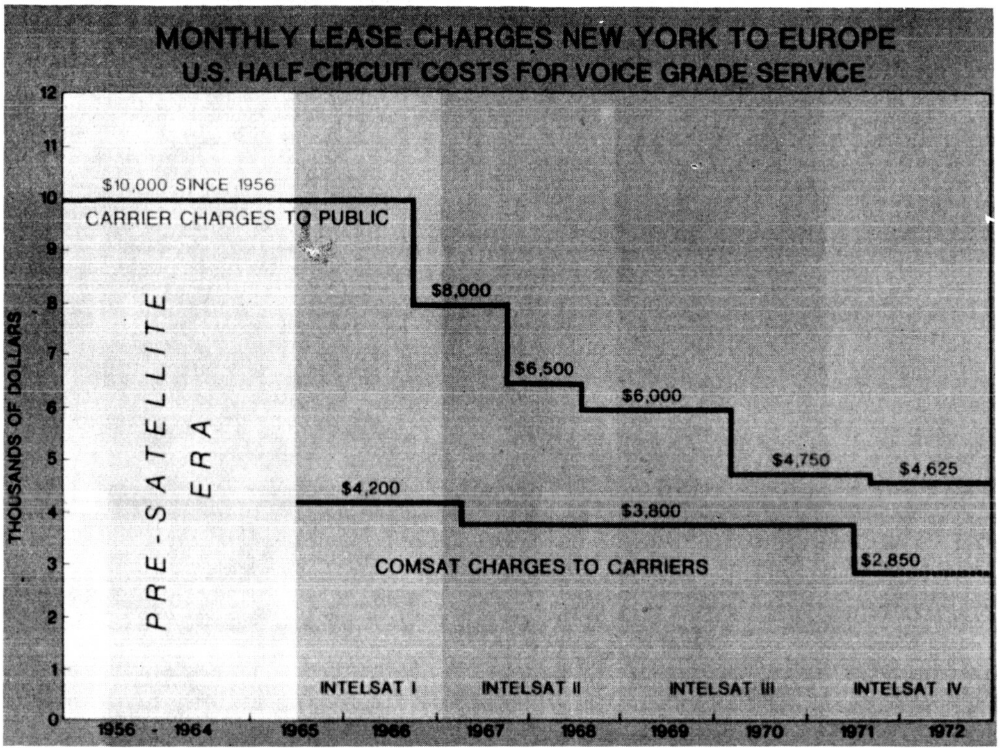

Figure 14. Monthly lease charges (New York to Europe).

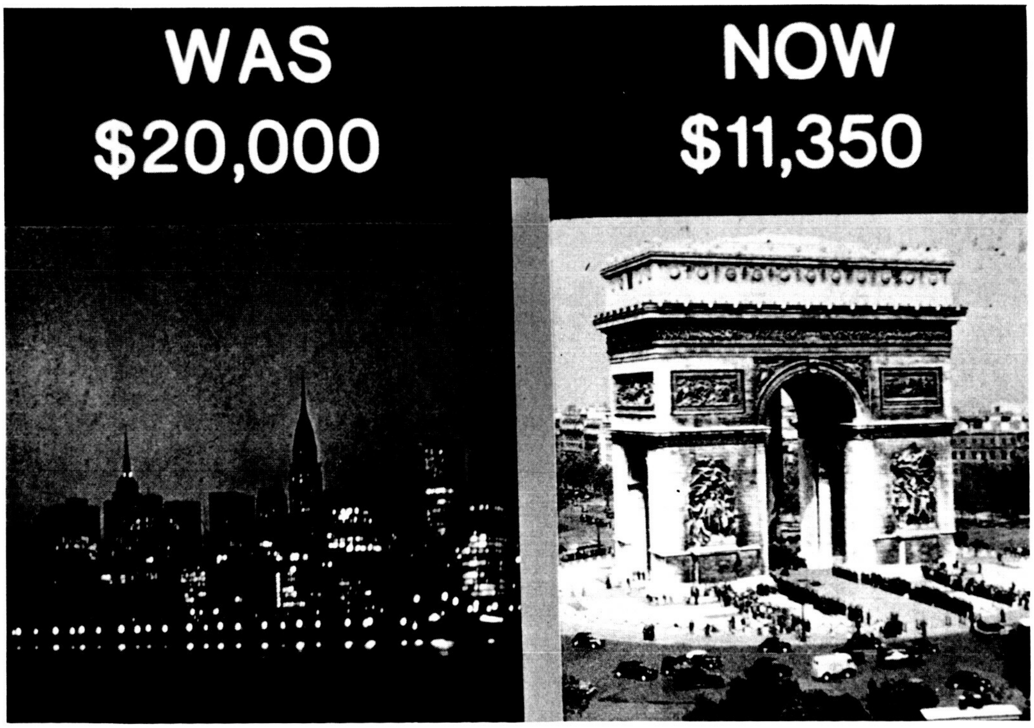

Figure 15. Circuit costs (New York to Paris).

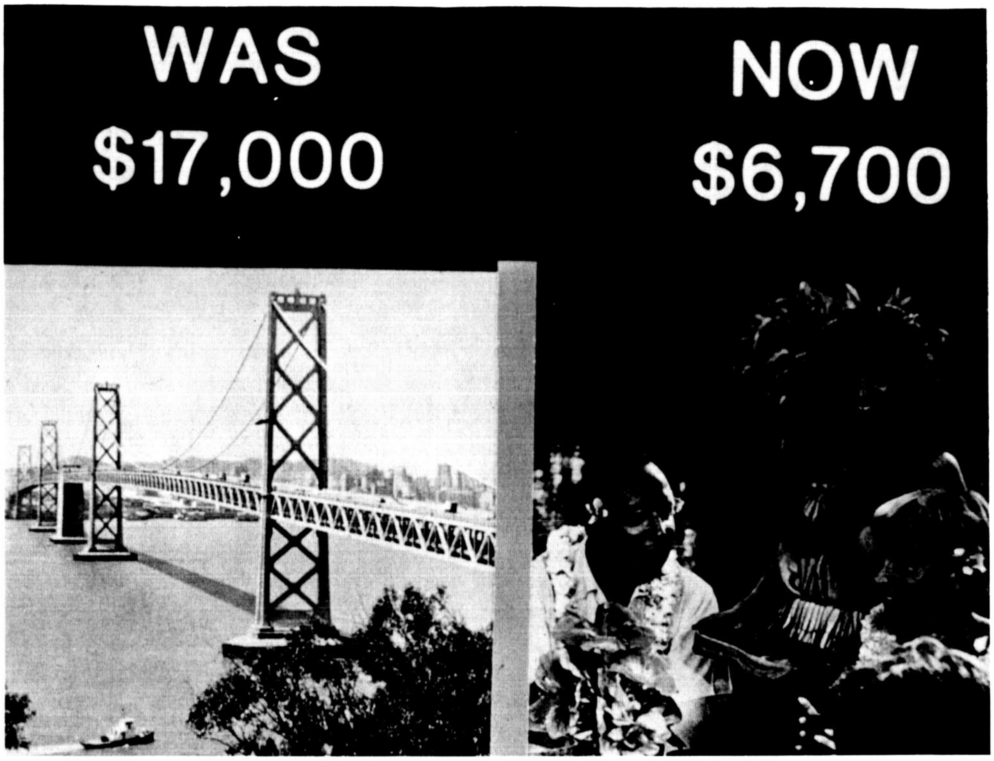

Figure 16. Circuit costs (San Francisco to Honolulu).

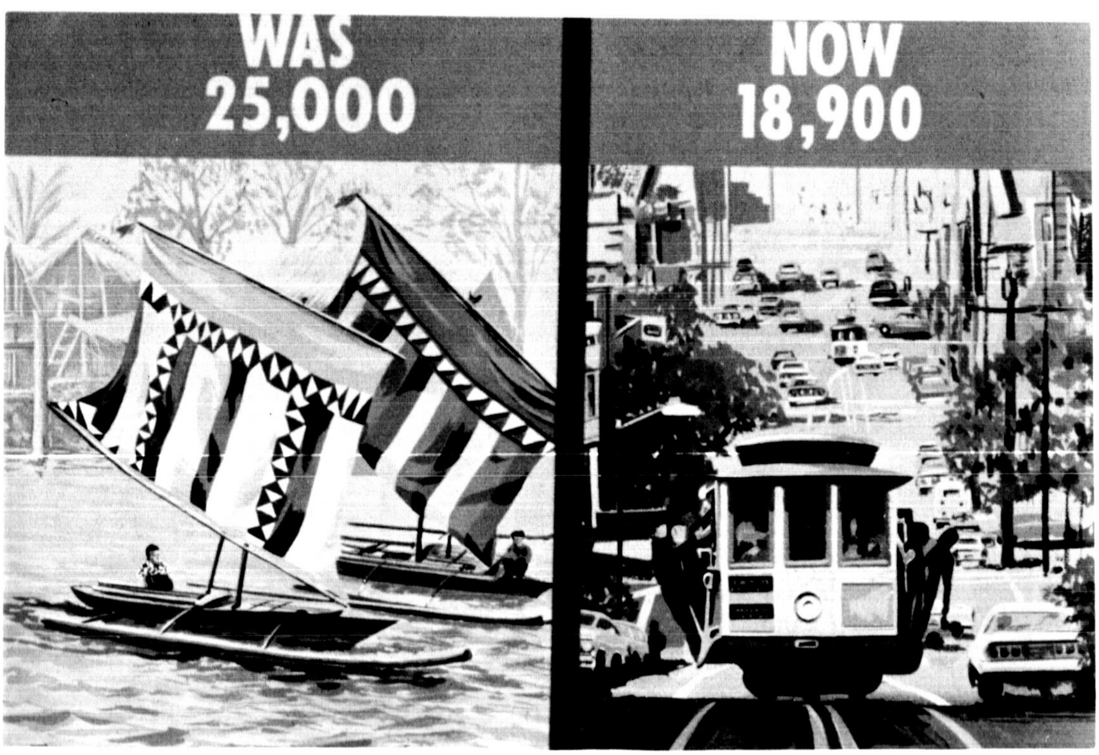

Figure 17. Circuit costs (San Francisco to Philippines).

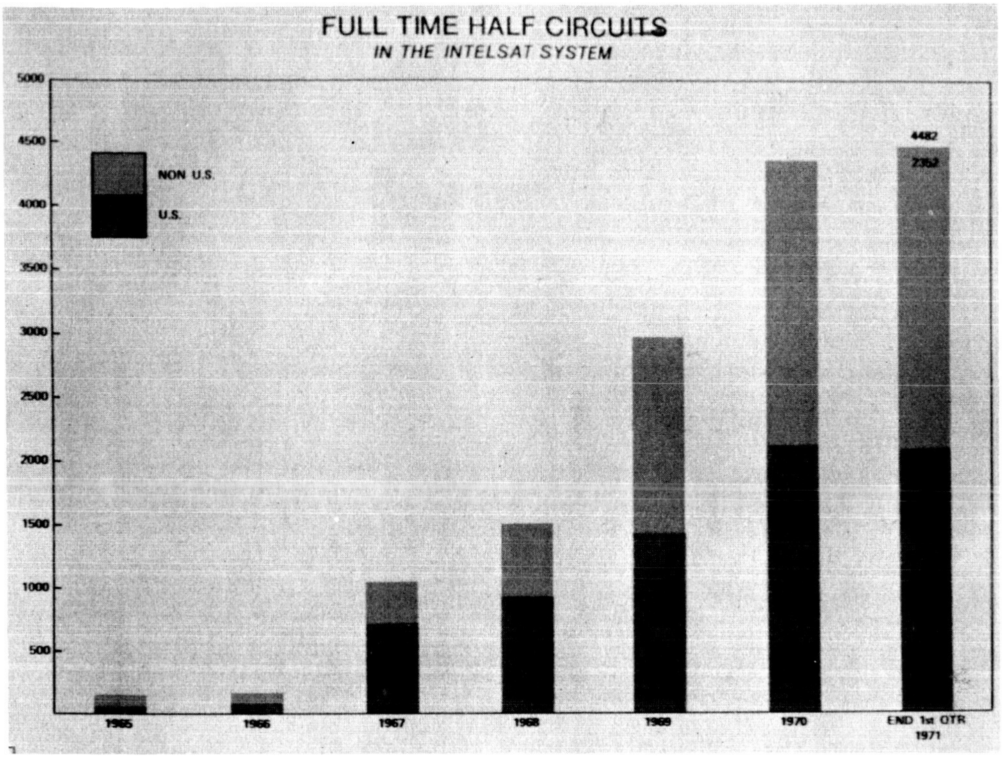

Figure 18. Full-time half-circuits in the INTELSAT System.

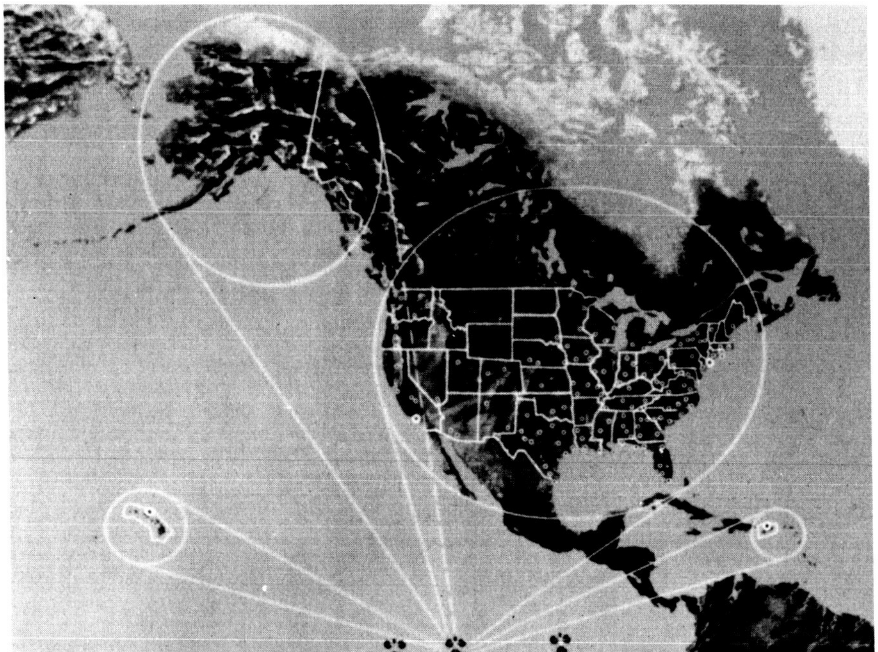

Figure 19. Multipurpose Domestic System II map.

Figure 20. Domestic earth stations (initial configuration).

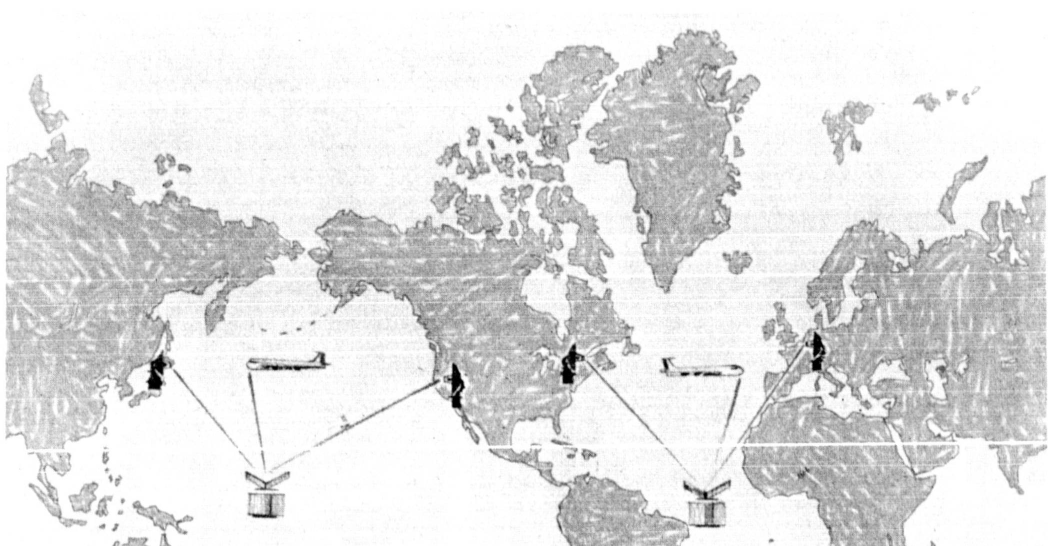

Figure 21. Aeronautical satellite services.

Figure 22. New dimensions, earth from the moon.