

## "SPACE 1999" AND CATV

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**ABSTRACT:** A generalized history of commercial satellite communications, with an eye to the future, is cited in this paper. As in all phases of modern society, it is important to know where we've been, where we are now, and where we might be going. The CATV industry is just starting to enjoy the benefits of satellite television. Our heritage is short but our future seems to be endless.

The domestic satellite system is adding a new dimension to CATV, and the further exploitation of this broadband capability is making available to the public novel and versatile communications services.

Early Bird or Intelsat I was the world's first communications satellite, and was placed in service in June, 1965. It made live transoceanic TV possible for the first time. In the eleven years since Early Bird, satellite capacity has been increased from 240 telephone circuits or one television channel to 6,250 telephone circuits or 20 TV channels. Space segment costs per telephone circuitry-year have dropped from about \$32,500 in Intelsat I to less than \$800 in Intelsat V.

We have seen the EIRP of the spacecraft increase from +15 dBw of Early Bird to the present +35 to +38 dBw of our current DOMSATS. With this hundred-fold increase in available signal, the terminal requirements on the ground have become less stringent. With regard to CATV receive only stations, this means smaller antennas and/or higher noise amplifiers at the front end. In that area, we have progressed from the cryogenically cooled MASER and paramps, to room temperature paramps and GAASFET amplifiers.

The typical earth stations for CATV/TVRO presently consist of a 33-foot dish with a gain of about 51 dB, a low noise amplifier with a gain of 50 dB and a noise temperature of about 240°K. These units coupled to a satellite EIRP of 35 dBw and a high performance TV receiver yield video signal to noise ratio in the order of 55 dB under ideal conditions.

The first Intelsat, or Early Bird as it was called, weighed in at launch at 150 pounds. It could handle 240 telephone channels, or 1 TV channel. In its early life, it was turned off during non-peak hours. Although no longer useful for communications, its beacon is still being tracked.

Intelsat II ushered in a new era for satellite communications. For the first time, more than two earth stations were able to use the same spacecraft simultaneously. Weighing in at 357 pounds, this satellite maintained the 240 channel and TV capability of Early Bird.

The year 1969 saw Intelsat III placed into orbit with a launch weight of 647 pounds. Many important firsts were designed into this spacecraft. Among them was an increase in channel capability to 1500 circuits or 4 TV channels, and mechanically despun directional antenna.

Intelsat IV is still giving us a 3750 channel capacity. Its launch weight was 3120 pounds and has a 208-inch overall height. A first for the IV series is in its two steerable spot-beam antennas, which results in a higher signal level being received on the ground.

The Intelsat IV-A series are the current work horses of the international system. Being quite similar to the IV series, these birds have a 6250 channel capacity and have 20 transponders as compared to 12 in earlier series. This is accomplished through the use of simultaneous reuse of the same frequencies.

The next generation of Intelsats will be the V series and will make use of the 12 and 14 GHz band of frequencies. At this time, sufficient additional information is not available for publication.

But what about the future? What can we expect to see as technology advances? While working at COMSAT Labs, I was privileged to work with the C.T.S. Satellite Experiment, a joint NASA and Canadian venture. COMSAT is just one of the many user/experimenters. This satellite uses the K-Band frequencies of 12 and 14 GHz. But, the two biggest advantages are that a parametric amplifier at 14 GHz is on board the spacecraft, and a 200-watt TWT is being used at 12 GHz. Both are working well.

Because of the higher frequencies used, the lower noise front end and the higher power used in the satellite, the terminal equipment on the ground can be smaller and less expensive. To the CATV operator, this boils down to antennas of about six feet in diameter and two-way capability with about a 100-watt TWTA for video transmission.

Western Union's TDRSS, or Tracking and Data Relay Satellite System is the only planned satellite system

that extends into the 1980's. This system concept will make use of both C-Band (4-6 GHz) and Ku-Band (12-14 GHz) as does the proposed Intelsat V series. The advanced spacecraft designs planned for TDRSS will enable more people to reap the benefits of satellite communications.

There has been much talk of late concerning the use of lasers and laser technology for satellite communications. We may see this medium used for spacecraft to spacecraft linkages. However, because of severe atmospheric and water vapor attenuation, it is doubtful that we will ever see spacecraft to earth linkages made. Bear in mind that one small rain cloud can completely block out an optical link.

By the turn of the century, we may see many households with their own small earth terminal for the reception of TV, facsimile and telephone service. Within my own Amateur Radio Club, we are building a 2.3 GHz moon-bounced station. So, the basis for the advanced technology is here now. Let us hope that the private sector takes the ball and runs far. We all have a lot to gain.

As a final thought, if you are considering the implementation of Satellite TVRO, also consider that you

may want to expand your system to a two-way capability at the present 4 to 6 GHz. And, with an eye to the future in the higher frequencies, select the passive components with the idea that you may upgrade to K-Band within five to ten years.

Satellite technology is changing our lives. We watch news and sporting events from the other side of the globe as they happen. A local television station in Atlanta, Georgia became a national outlet overnight. A great deal of hard work, perseverance and money have made this possible. We, in the cable industry, are indebted to those who have, and are continuing to make our world a little smaller and a whole lot friendlier.

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