CATV Leakage: A Two-Way Street for Interference and Cooperation

Does it seem like you'll never win? Just when you thought you had the TVI situation in hand, the roles are reversed — ITV! Now you're the victim!

By Peter S. Carr,* WB3BQO

Interference has been a problem for radio amateurs since the early days. From the time of spark transmission to color television, amateurs often found themselves cast in the role of villain. Two recent developments have brought about a change in the amateur's role in interference cases.

The first development was the rapid growth of cable television (CATV). From a humble beginning in 1948, the CATV industry developed rather slowly until about 1972. At that time, changes in FCC rules, coupled with improved coaxial cables and CATV amplifiers, led the way not only to an increase in the number of CATV systems, but also in the number of channels used in the systems. Cable operators were originating programs locally and "importing" distant stations on microwave links. The mid-1970s ushered in the age of satellite communications for CATV operators. The rules and technology made more channels available, and the satellites delivered the programs to fill them. Today, the RCA SATCOM 1 satellite carries 24 channels of programming designed specifically for cable TV systems. The subscribers love it! Little wonder then that the number of CATV systems with over 29 channels more than doubled during 1980.

Coaxial cable shielding and the stronger signal voltage delivered to the TV antenna terminals by the CATV systems proved to be an advantage to the Amateur Radio community. Properly installed and maintained, cable systems meant a lot less TVI resulting from amateur hf operation. No one lamented the passing of corroded TV antennas and easily overloaded preamplifiers! So everything was looking better — right? Well, not quite.

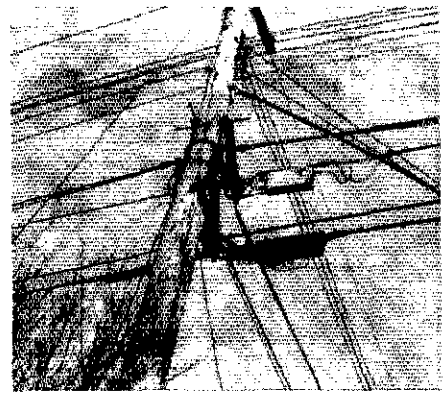

Fig. 1 — A typical utility pole with a CATV amplifier station mounted on a 1/4-inch steel support wire. Most CATV lines are mounted above the highest telephone cable and below the secondary electric wires.

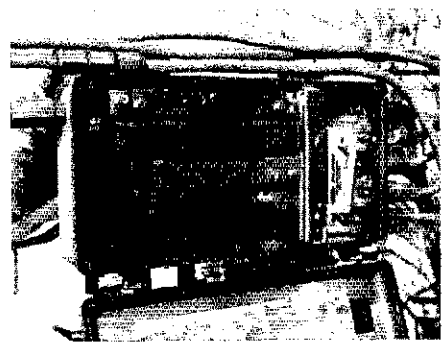

Fig. 2 — Interior of a CATV amplifier. Incoming trunk signals enter the housing at the upper left and exit at the top right of the housing. The vertical module is a high-level distribution amplifier that feeds four smaller cables going to houses in the immediate area. Both amplifiers are powered by 17-V dc, which is derived from an ac voltage that is fed down the coaxial cable.

Another development has occurred in the last decade: the explosive growth of amateur vhf-fm repeaters. Most parts of the country are served by at least one repeater, and a variety of choices is frequently the rule. A network of fixed, mobile and hand-held radios operating through a repeater has become the standard communication system for local emergency communications. The channelized operation of vhf fm, combined with telephone interconnection, has helped make this mode a favorite for portable and mobile operation. Today, the 2-meter fm transceiver, in its many forms, is the most commonly found piece of Amateur Radio communication equipment.

How has all this changed the amateur's role in interference? To provide all those extra channels, CATV systems legally use the full range of frequencies from 54 to 456 MHz — this includes amateur frequencies. Only a fraction of a microwatt is delivered to the subscriber TV antenna terminals. In the bigger, better shielded cable, power levels may approach 1 W. Even if a video carrier falls in the 2-meter band (145.25 MHz typically for cable channel "E") there should be no problem, at least theoretically.[1]

Leaks and Leakage

A corroded connection, a physical

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[1]Many new, larger systems use the HRC (harmonically related carriers) system. In that scheme, the channel E visual carrier is at 144.0 MHz. For a variety of reasons, carriers are sometimes slightly offset from nominal frequency. For a listing of CATV channels, see February 1982 *QST*, p. 14.

break or other damage to the system line or connectors, as well as poor quality components, can cause a signal leak. Where leaks exist, signals inside the cable escape and are radiated. (The lower the frequency, the more noticeable the radiation from the leak.) If the cable system uses channel E, there will be a 145.25-MHz visual carrier and sidebands being radiated in the vicinity of a leak. Roles are reversed as the radio amateur's reception is interfered with.

The role reversal is not complete, however. The leak that lets signals out of the cable also lets signals from outside enter into the cable; you might say it is a two-way street. The amateur hears interference in his receiver; when he transmits, it enters the cable and disrupts channel E reception. The neighbors complain! Will the cable company repair the leak?

Legal and economic reasons compel responsible CATV operators to repair leaks in their systems. Part 76 of the FCC rules requires CATV operators to check their systems for leaks at least once per calendar year. They are required to keep a log of leakage problems, causes and remedial measures taken. The rules (§76.610) limit allowable leakage in the 54- to 216-MHz range to 20 μV per meter at a distance of 3 meters (10 feet). In addition, harmful interference to other services is not permitted (§76.613).

For obvious economic reasons, the CATV operator wants to deliver high-quality signals to his subscribers. Leaks mean signal loss, and that means poor reception. Subscribers are not willing to pay for poor reception. That is especially true when the interference is to a premium program service. Channel E and the other mid-band channels in the 108- to 174-MHz range typically carry the movies and entertainment specials that provide added income to the cable company. Subscriber complaints are usually the first indication of a cable leak.

Not all cable systems use amateur frequencies inside the cable. If the system in your area does, and if you experience leakage problems, then you may want to know how to locate leaks on your own.

Begin by enlisting the aid of a couple of ham friends with rotatable antennas. Use the method of triangulation to narrow down the leakage location to a few square blocks. Place a battery-operated TV set in a vehicle and a pair of "rabbit ears" on top. Select a channel that is used in the cable but is not used for broadcasting in your area. With one person to drive and another to watch the TV screen, take a trip through the suspect area.

As you begin to approach a fault location, the first indication will be faint sync lines running either vertically or horizontally across the screen. As signal strength increases, faint images will appear, then fade, roll and return; this is caused by multipath signals reaching the antenna. When the picture stabilizes and becomes snow free, it indicates that the leak is very close. A return to snowy pictures indicates that the leak has been passed.

For ease of maintenance, most all cable equipment is mounted on the steel support wire close to a utility pole. The large majority of leaks that occur in the aluminum cable system center near these devices. For that reason, you should locate the pole nearest the spot where snow-free pictures were received. You can inspect the area from the ground, if you wish. For safety and liability reasons, make no attempt to climb the pole for a closer look. Copy the identification number on the pole and report your findings to the cable company.

A hand-held transceiver can be used to trace high-level interference to 2-meter communications. Remove the antenna and tune to a frequency around 147 MHz. You should be able to pick up sync and video sidebands when you are near a leak. With the antenna connected, the transceiver becomes a very sensitive leak detector. The sound carrier is 4.5 MHz above the video carrier. Less ambiguity will result from tuning to the sound signal, when possible.

Fig. 3 — Signal-level meter used to adjust amplifier levels. Continuously tunable from 54 to 300 MHz, the meter can be used for testing mid-band and super-band channels. It is battery powered and can be used with a small antenna to isolate cable leaks. Sensitivity is not great because the meter has broadband response.

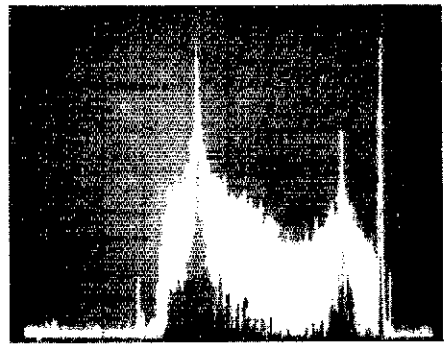

Fig. 4 — Spectral display of a channel E television signal. Horizontal divisions are 1 MHz; vertical divisions are 10 dB. At 145.25 MHz, the visual carrier (on the left) is the highest energy-level component of the composite TV signal. Notice that the chroma subcarrier and the aural carrier (on the right) are both outside the 2-meter band.

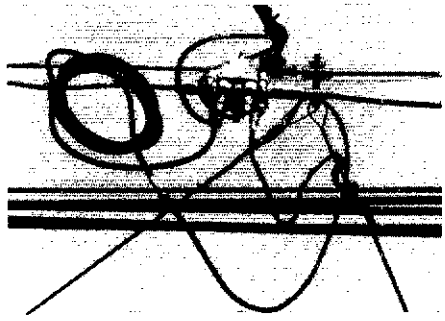

Fig. 5 — Directional tap unit installed in the aluminum distribution cable. Smaller drop lines are connected to the tap; the one at the left has a pay TV trap installed in series. Each connector may allow water to enter the cable, corroding the shield and causing radiation leakage.

Other Observations

Not all leaks are located along the main cable. Cuts, breaks and corrosion on the subscriber drop cable are other sources of leakage. The good news is that the intensity will be less because signal levels are lower there. The bad news is that it can be hard to locate the source when several drop lines leave the cable from a single point.

Faults that are not located along the main cable near the poles are found mostly inside the subscriber homes. Lengths of twin-lead used to connect other TV sets or fm stereo receivers to the system are common offenders. Improper connection of video games and video cassette recorders will frequently cause leaks and will usually result in poor reception as well. I even heard of a fellow who connected his outside antenna in parallel with the cable at the TV set antenna terminals. Now that was a leak!

In the past, the amateur has looked upon CATV as a friend that offered a measure of protection against RFI to consumer electronic devices at no cost to the amateur. Today, it is time for hams to work actively with cable system technicians, a large number of whom are also hams, to control the CATV leakage problem. Each Amateur Radio operator is responsible for the proper operation of his station — emitting clean signals, reducing harmonics, using only enough power to communicate effectively and comply with the other FCC rules. CATV systems must also live up to the intent, not just the letter, of the FCC rules. Cooperation among all concerned will bring about the greatest benefit to all.

Peter S. Carr has been a licensed radio amateur since 1974, upgrading to Advanced class in 1978. His electronics background includes radar, telephone and cable-television systems operation and maintenance. Since 1972, he has been employed as chief technician and manager of Tele-Media, Inc., of Ridgway, Pennsylvania — a 3400-customer cable TV system. Pete also maintains the W3IE 2-meter repeater (the antenna is halfway up the 500-ft CATV tower). He has written a number of articles for Amateur Radio and R/C modeling magazines.