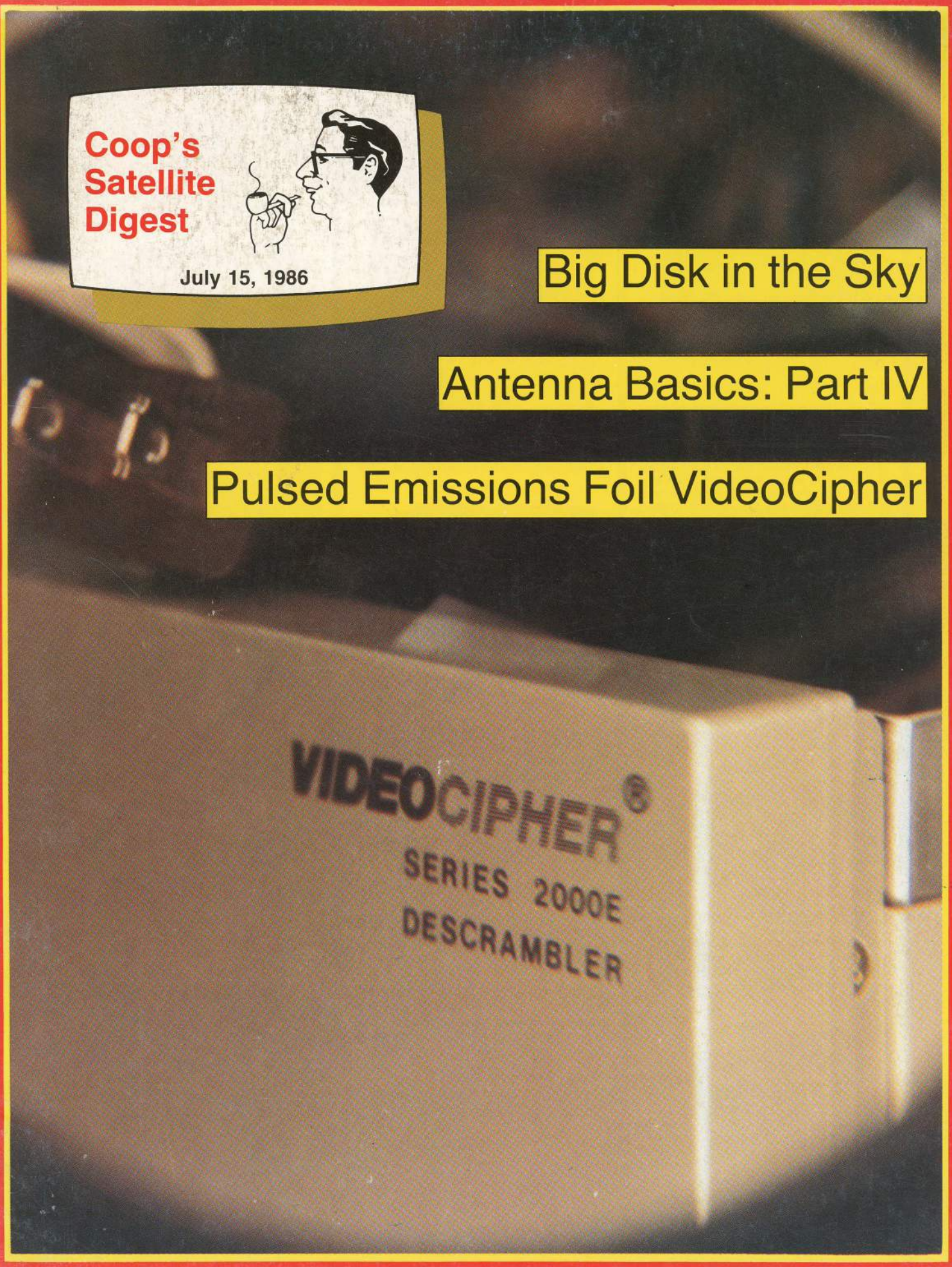
Coop's Satellite Digest

July 15, 1986

Big Disk in the Sky

Antenna Basics: Part IV

Pulsed Emissions Foil VideoCipher



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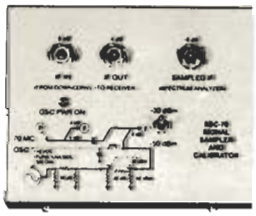

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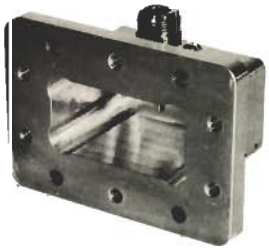

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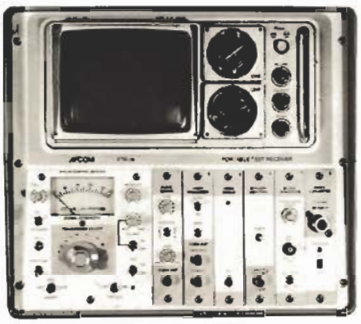

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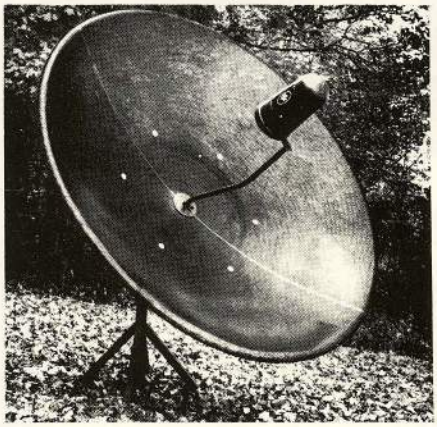

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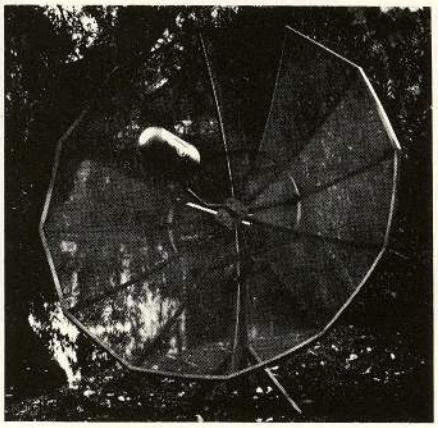

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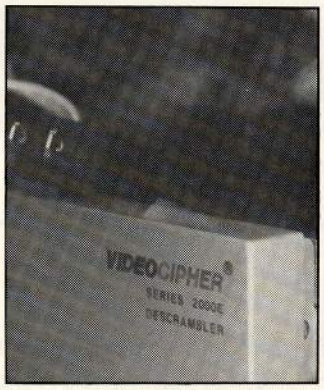
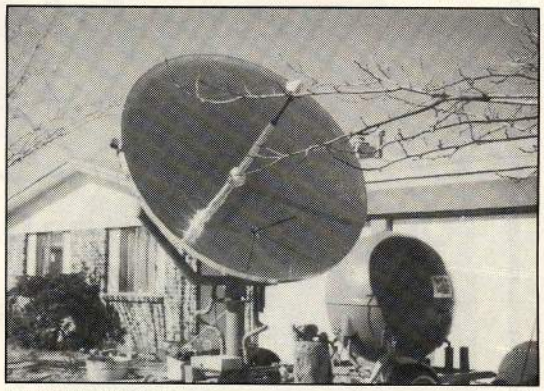
JULY 1986

COOP'S SATELLITE DIGEST

OUR COVER/'Pulling The Plug on VideoCipher'; a special look at the many reported 'hot wiring techniques' for VideoCipher begins in CSD August 15th. ▶





Beginning with the August issue, Coop's will be published by Bob Cooper. All inquiries, advertising and subscriptions should be addressed to Bob Cooper, West Indies Video, P.O. Box 100858, Ft. Lauderdale, FL 33310 (305/771-0505).

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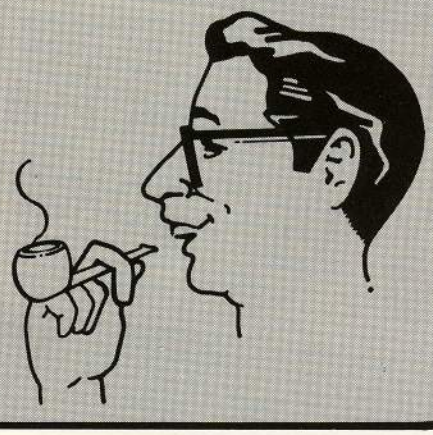

Our Continuing PR Problem

Cable industry leaders, such as those from TCI (i.e. John Sie) are accused of dealing off both sides of their desks. TCI's Sie sat on a stage with me in Las Vegas during the industry's spring convention and asked that the rhetoric of SPACE leaders be toned down so that more constructive dialogue could begin between the two industries. I liked the message.

I am not as pleased with something called 'Publisher's Letter' appearing in March, 1986 issue of a publication called Cabletime, which the front cover says is 'A TCI Cable Guide Company.' Cabletime is a guide publication created by and for TCI's many hundreds of cable systems, and sent into cable subscriber homes each month. Most of the larger MSO firms follow the same technique to keep viewer/subscribers informed, and it also gives them an opportunity to promote their optional subscription channels as well as to make some bucks selling advertising to local businesses.

The particular issue sent to me by a CSD reader (Pete Griffin of Greenfield, Wisconsin, at Front Line Communications) is customized for the Chicago area TCI systems. The editorial that bothers me is headlined: "FAIR In the Air (...Finally)." It deals with the act of scrambling by cable programmers. I'll get to the editorial and the points it makes about home dishes shortly.

TCI's editorial concerning home dishes in March was hardly the only coverage given to scrambling of satellite signals during the month of March. There were numerous other cable publications, sent to cable subscribers by other cable firms, that touched on the same subject. I suppose it must be a coincidence that so many cable-to-subscriber publications selected March to publicize the scrambling. An example of others doing the same thing in their March issues is found in the March 'Cable Highlights' material published by Continental Cablevision, another major MSO. There, in a question and answer section, the following question appeared:

> "Q: I've heard that HBO and Cinemax are scrambling. How will that affect me?
>
> "A: As a cable subscriber, it won't affect you at all. It will only affect owners of satellite dishes who aren't paying for their HBO or Cinemax services. HBO and Cinemax have scrambled their signals to protect artistic copyrights as well as your rights as a customer. Scrambling does not interfere with the quality of your HBO or Cinemax reception, or your ability to record programs."

TVRO is of course overly sensitive to the entire subject of scrambling and the frequency with which that subject appears in cable literature. We might read all sorts of subtle intents into the appearance of this question in the Continental Cablevision publication; or the fact that this was the only question dealt with in the publication for March. Did that mean Continental received no other questions concerning cable or satellite service in March? We doubt that.

But back to the editorial in the TCI guide. It starts off with an interesting statement.

> "We have received many letters of protest from cable subscribers who pay for their service and thus resent the fact that others simply point a satellite dish towards the heavens and receive cable programming for free."

I would love the opportunity to first see those 'many letters' and then to talk on the telephone with those people who allegedly wrote those letters. Webster defines many as 'adding up to a large number, numerous.' I have some difficulty envisioning a large number of people sitting down to write their local TCI cable company to 'protest' that some people have bought home dish systems to watch satellite programming.

The TCI editorial goes on:

> "Now, at long last, the suppliers of cable programming have individually decided to scramble their signals to prevent non-paying viewers from enjoying their product...virtually all major suppliers of programming in the United States plan to scramble their signals by the end of the year."

HBO and others, including TCI, have repeatedly told Congress that the scrambling was implemented primarily to cut-off commercial users such as motels and small cable firms who were using the programming without paying for it. This TCI editorial makes no mention of this facet of scrambling, and builds a case against home dish owners as the only reason for scrambling. It is difficult to know whom to believe but I prefer to believe that both motel and home systems were of some concern to the cable programmers and systems. The 'at long last' phrase is a strong editorial opinion, of course, revealing that in the editor's mind the action was overdue and should have been done sometime prior. We get his message, loud and clear.

The editorial goes on to note:

> "As a cable subscriber, you will not notice any difference; your screen will retain its clear, high resolution image. But satellite dish owners will not be able to receive a discernible signal without buying or leasing a descrambling device from their local cable office or other sources. In addition, just as cable subscribers pay a monthly fee for programming, satellite dish owners will also have to pay for their programming on a regular basis. That's only fair."

Coop/continued on page 25

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ANTENNA BASICS

Part Four

by Jim Vines

Now consider a more compact antenna size, 14 feet. Here our goal is to extract watchable video from the stronger Intelsat transponders and true (53 dB SNR) broadcast quality video from all DOMSAT transponders of 34 dBw or more.

It should be noted here that Intelsat-DOMSAT feeds are available from OEMs such as Seavey Engineering Associates. Using a DOMSAT feed for Intelsat reception or vice versa results in a 3 dB gain penalty; as all domestic satellites use linear (vertical or horizontal) polarization while the Intelsats and other international birds use either RH or LH circular polarization.

At 26 dBw, a typical Intelsat hemispherical beam transponder is fully saturated. In back-off mode it will operate at about 22 dBw.

For simplicity, we will assume full 36 mHz transponder bandwidth and a receiver IF bandwidth of 30 mHz for both the Intelsat and DOMSAT scenarios. (See Table 8.)

Buyer Beware

Until offset antenna technology is as well understood as conventional antenna technology, professional installers need to exercise considerable caution. Some general rules follow: The first offerings (from Pico, Birdview, Lowrance, M/A-Com, Prodelin, CommTek, and Microdyne) are of one-piece construction and should be quite accurately contoured. Compromises to surface accuracy, harmful to gain, are devastating to side lobes, resulting in reduced rejection of adjacent satellites, TI and thermal noise from the ground.

Very soon there will be an assortment of segmented mesh (and solid) offset antennas. The ethical OEM will take pains to provide the dealer/installer with some means to verify surface accuracy.

Ordinary feeds will not work with offset dishes for several reasons. Reason number one is that the angle subtended by the offset dish is relatively small so there will be severe spill-over illumination. This applies to both round and rectangular offset dishes.

Reason number two is that the feed is severely slanted (about 45 degrees) away from the dish's optical axis.

Reason number three is that with shaped beam designs, mechanical skewing of the feed results in drastic reduction of cross polarization discrimination. In fact, it is possible for the feed to become circularly polarized. (Whether the degree of circularization would be adequate for Intelsat work is a matter of conjecture, however.)

Reason number four is that to fully exploit the low noise temperature/high G/T potential intrinsic to offsetting, the feed itself must contribute very little to the total noise temperature of the antenna; which is measured at the rear flange of the feed. Among other things, feed tolerances must be kept very tight. Simply tilting an ordinary round dish and placing the feed somewhere outside the edge will not work. Conventional and offset antennas both require the feed to be at the dish's focal point which is situated along the dish's optical axis.

Mounts And Aiming

One of the first things observed by the novice TVRO installer is how difficult it is to hit the satellites. The relatively high gain (directivity) of even a 6 foot TVRO antenna is a formidable challenge to the beginner.

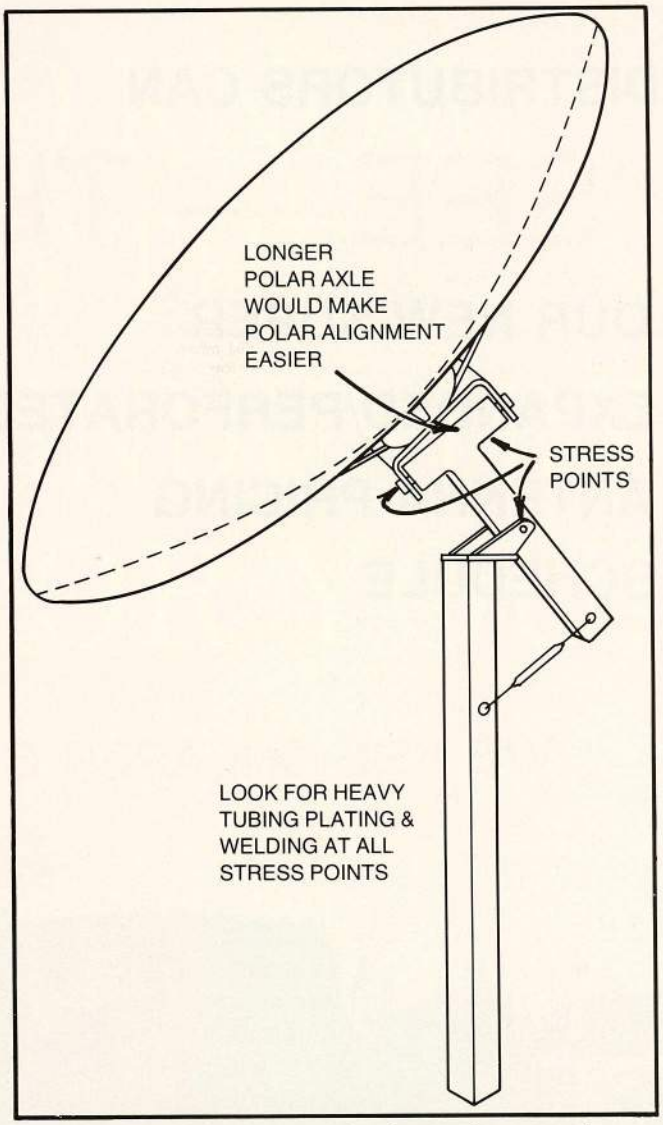

Diagram 27—What to look for in a polar mount (actuator omitted)

The mount not only aims the dish, it must keep it on target. Considering that the half power beamwidth of a 6 foot dish is about 3 degrees, it becomes apparent why a rigid mount is important. With increased size comes the need for additional rigidity. For example, doubling dish size from 6 to 12 feet will, assuming that adequate surface precision is maintained, result is halving of the HPBW from about 3 degrees down to 1.5 degrees.

The mount should support the dish at widely separated contact points in order to minimize both static and transient load concentrations which might distort the dish or cause outright structural failure to either the dish or the mount. The supporting pole (that's not why it's called a polar mount!) should be rigid and it should be anchored by a proper foundation.

Aiming

For the antenna to accurately track the Clarke Geostationary Orbit Belt, the polar axle must be aligned with the Earth's axis. (The rather

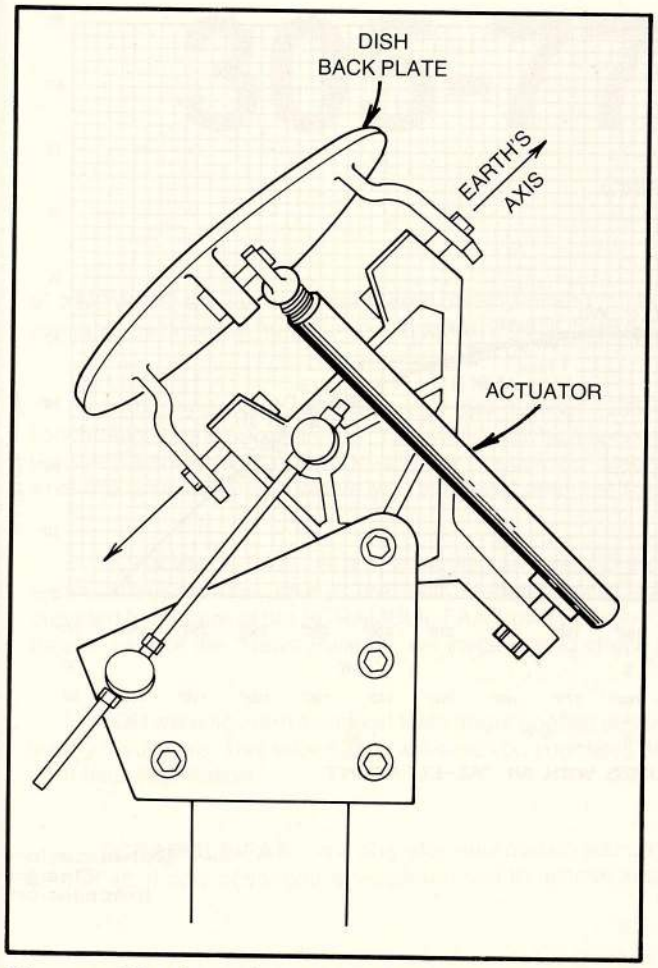

Diagram 28—Questions to ask about any mount: Is polar axle long enough? Are actuator contact points located so as to minimize stress? Are the materials selected adequate to withstand load concentrations? Are declination adjustments easy and precise?

short polar axles currently in vogue make accurate polar alignment a chancy, hit-or-miss affair.) The North Star (Polaris) is only .4 degrees removed from exact alignment with the Earth's axis; so it is a handy night time alignment target for mounts that have long polar axles.

Fortunately, some polar mounts permit an azimuth adjustment to be made to the polar axle. Thus, the polar axle can be adjusted sideways (east/west) as well as up-down (north/south). It is still essential to know which way is north. Having been asked to assist at installation sites over the years, I have found that some installers do not know how to determine which direction is north.

Shadows point north at high noon. High noon is not the same as 12:00 noon, unless the TVRO site is located at 60, 75, 90, 105, or 120 degrees west longitude; in other words, some multiple of 15 degrees. At these even longitudes, which are easily found in an atlas, 12:00 standard time (or 1:00 daylight time) occurs at precisely high noon. What if the site location is at an odd longitude (not 60, 75, 90, 105, etc)? If you are in Hoopeston, Illinois (40 degrees 30'N, 87 degrees 40'W), high noon occurs at 6 minutes, 34 seconds before 12:00 standard time. (See Table 9.)

Why not rely on a compass and just make appropriate magnetic corrections? One can, but the astute observer can cue in to a vast array of environmental reference points (of which shadows are but one) that he comes to regard the compass as a guide, not gospel. Frankly, there are places where a compass is useless. For example, iron ore concentrations are a major disruptive influence on a compass. The Canadian Arctic, because of its proximity to the North Magnetic Pole, is regarded by bush pilots as a region of compass unreliability. Fifty years ago the ability to navigate without a compass in the Arctic was essential to survival. It still is if you are aiming a satellite antenna.

In addition to finding due north, the proper elevation for the polar axle must be determined. To do this, simply subtract the site latitude from 90 degrees. For Hoopeston, Illinois: Polar Axle Elevation = 90 degrees - 40 degrees 30' = 49 degrees 30' (See Table 10.)

The first region of the Clarke Orbital Belt to track during set up would generally be south. The middle of the Clarke Belt is the place to measure dish elevation. Optimize for east/west, then for up-down (north/south). With a peaking instrument like Northwest Satlabs' Tweaker (TM), this is easy; without a metering instrument there is the slower null-center-null method of peaking.

The null-center-null method works better with manual adjustments where the number of crank or screw turns can be counted. De-aim until the signal is lost and then turn the dish back across the signal until it is lost again while counting the number of crank turns. The best signal will be obtained by going back halfway (number of turns divided by two). However, the dish can track accurately and still not acquire satellite video. Assuming all connections are good, the LNA is functioning normally and the receiver is in scan mode, there is the possibility that the feed is off-center.

If everything checks out and there is still no satellite video, what else could be wrong? Terrestrial Interference (TI) is a possibility. Recently a local TVRO dealer encountered a situation exactly like this while setting up for a street corner demonstration. A couple of arc-swings of the dish produced muffled cross-talk and intermittent smudging and windshield wiper effects on the monitor. With the receiver set to transponder 6, the cross-talk was found no matter where the dish was aimed. The dealer was advised to pull his TVRO to another spot several blocks away which was protected by dense foliage, where good quality reception was obtained.

Types Of Polar Mounts

While all polar mounts are designed to track across the Clarke Belt, there is a vast selection of available designs. Our objective is not to endorse the product, but instead to suggest what to look for when comparing alternative designs. Remember that all TVRO antennas are wind collectors. (Ask anyone who was at the Las Vegas STTI show in 1983!) When Winegard advertises that their perforated skin eliminates 36% of the surface area (meaning that their surface is 36% open), this means that 64% of the surface area remains (is closed). Perforated and expanded mesh dishes do let some wind through. Eddies of wind build up on the fronts and backs of all dishes causing a rocking motion if the mount is not structurally adequate.

Is there play where the actuator fastens to dish and mount? If there is the antenna will rock in the wind. Rocking creates repeated transient load concentrations and ultimately structural failure. The prudent installer will remember that most home TVRO system owners can afford good lawyers. Play not only leads to structural failure, it also leads to user frustration after the new wears off the system. Even on windless days, play becomes a source of frustration when the dish is aimed near the middle of the Clarke Belt, due south. Here the dish's center of gravity is directly over the polar axle; an unstable position. When aimed due south, the dish will rock, and the video will flicker or in some cases totally drop out.

Site Planning

Even rural TVRO sites can have obstructions. Suburban and urban sites generally have more obstructions. When first visiting a prospec-

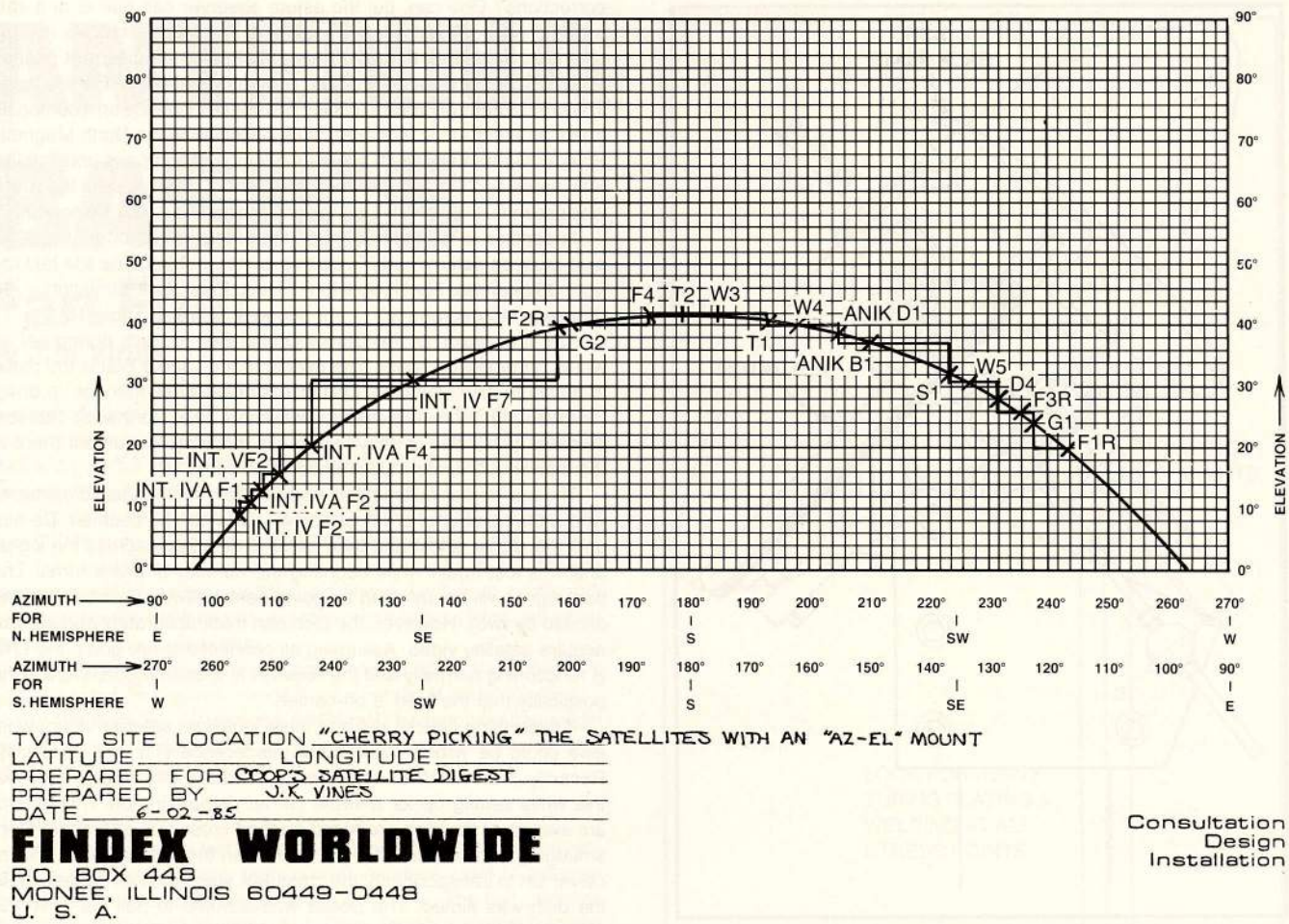

Diagram 31—Az-el "tracking" is a little like playing with an "Etch-a-sketch" toy; an azimuth-elevation mount permits exact aiming at all satellites across the Clarke Belt plus the elliptically orbiting Molnya birds in the northern sky.

tive customer, it not only is convenient to have in hand a complete visual plot, it adds a genuine touch of professionalism. Using such a plot (see footnote 5) shows the prospect in a way that he can visualize where the satellites are located, and what the mysterious Clarke Orbital Belt looks like.

A visual plot of his site shows the customer the enormous array of satellite choices available up there; including the Intelsat birds which require a 16 foot or larger antenna. This is a sales tool designed to help the prospective customer visualize the benefits of owning a TVRO system that has more features/higher performances than he might otherwise buy. It is a marketing axiom that customers buy because of perceived value.

Horizon-To-Horizon Tracking/Fad Or Trend?

If a newly introduced piece of TVRO equipment is useful, it catches on and becomes a trend. If its real world utility is limited, its market acceptance is arrested at the fad stage. After early attempts to market horizon-to-horizon polar mounts, the concept has been professionally packaged by several OEMs (Paraclipse, Continental) and at least one major distributor (Echosphere).

Horizon-to-horizon simply means tracking the Clarke Orbital Belt in its above-horizon entirety, which amounts to about 160 to 170 degrees of arc coverage at TVRO sites throughout most of the USA. Considering that virtually all DOMSAT TV originates within a 74 degree arc (69 to 143 degrees West longitude), is full horizon-to-horizon coverage useful? Paraclipse offers the full arc feature with their 4.8 meter model which has sufficient size and (given reasonable care in assembly) sufficient gain and G/T performance to access the Intelsat birds over the Atlantic. ADM also offers a horizon-to-horizon mount with their highly regarded 20 foot (6.1m) antenna; although they haven't promoted it as aggressively as the Paraclipse product. Large, high gain antennas that can see all the way from east to west are certainly more useful than those whose arc coverage is limited to DOMSAT coverage. Check one for the useful column.

For structural integrity, freedom from stress concentrations and sustained pointing accuracy in high winds, the radius of the chain drive should be a reasonable fraction of dish diameter. Conversely a 16 or 20 foot dish whose chain drive wheel has a radius of only 2 feet (or less) is neither structurally sound nor likely to stay locked on station. Because larger antennas have narrower half power beamwidths than small antennas, sustained pointing accuracy requires the mount designer to do his homework.

Paraclipse does employ a rather short sprocket wheel radius but also uses a 200 pound counterweight behind the dish moving the "moving mass's" center of gravity back to where the polar axle is. This is most important since it eliminates instability when the dish is aimed due south and also dampens out the buffeting effects of high winds.

The ADM wheel has a radius of about 3 feet. Taken as a percen-

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tage of dish diameter, the ADM wheel is roughly 15% (3/20ths) versus 12 1/2% (or 2/16ths) for the Paraclipse unit. Paraclipse and ADM have addressed the structural aspects of horizon-to-horizon tracking while remaining cost-effective. Check number two for useful.

Now consider small dishes in the 10 to 12 foot range. There is little that a 10 foot dish can extract from the Intelsat birds even when equipped with a right-hand circularly polarized dish and an ultra low noise amplifier, other than tearing, weaving sync bars. Is horizon-to-horizon coverage useful if your customer can only use one third of the full arc? Mechanically, horizon-to-horizon mounts show considerable promise. For example, they enjoy constant leverage across their full range as opposed to the varying leverage intrinsic to traditional telescoping actuators.

An Alternative Horizon-To-Horizon Design

For years, the mainstay of the CATV and broadcast industries has been the azimuth-over-elevation or az-el mount. The 360 degree carousel design allows the antenna to be panned and tilted anywhere in the sky, even north where the elliptically orbiting Molnya satellites can be found.

The Intelsat birds, notorious for their sometimes more lax station keeping, describing figure eight patterns about their assigned orbital locations, are relatively difficult for a tracking polar mount to access; unless equipped with a motorized declination adjustment.

Even for a given TVRO site location there is some decrease in declination as satellites east or west of center are accessed. At latitude 30, this variation amounts to about 0.6 degrees (+/−0.3 degrees) across the Clarke Belt. The perceptive installer will optimize the count for southeast and southwest sectors of the Clarke Belt, reducing maximum variation to +/−0.3 degree. (See Table 11.)

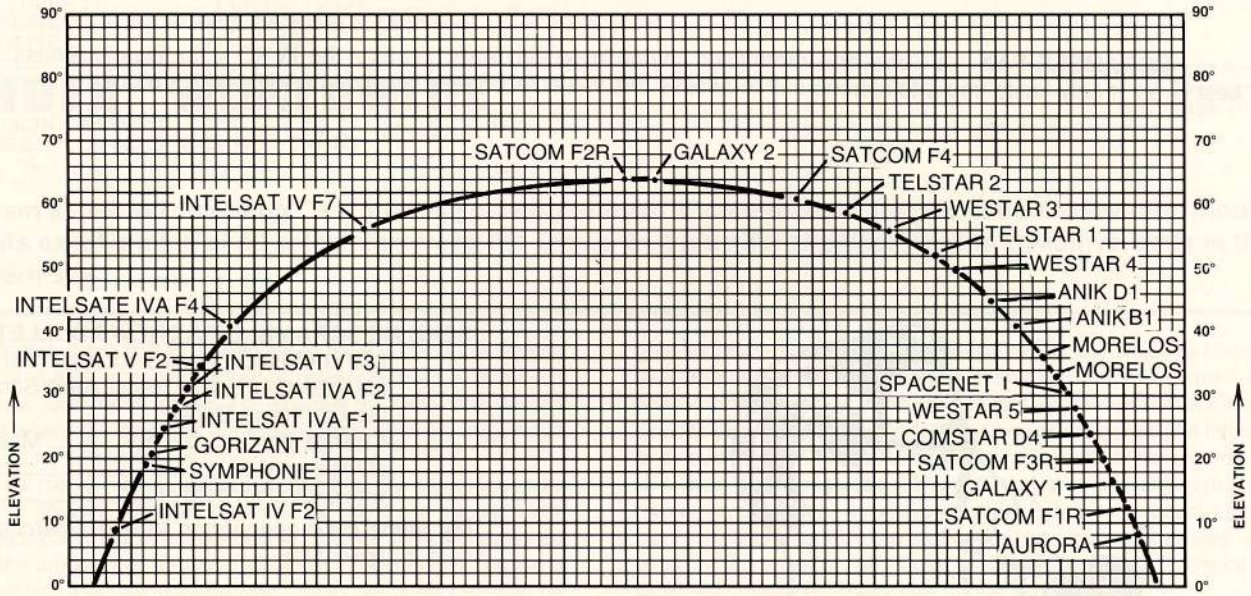
How much receiver input CNR is lost when a precision constructed, high gain 16 foot antenna is mis-aimed just 3/10ths of one degree? If the receiver input CNR is less than 2 dB over threshold, there will be a perceptible degradation in video quality.

For a precision 20 foot antenna a 0.3 degree pointing error costs about 1.2 dB of antenna gain; for a precision 24 foot antenna, the penalty increases to about 2 dB.

Is the azimuth-elevation mount design useful for home TVRO applications? In the hands of a competent designer (how many times have we heard that?), the az-el design offers superior rigidity and pointing accuracy. One can go to a job site, cold, with nothing more than a findex plot (as this writer has in places such as Tuktoyaktuk and Tegucigalpa), and bulls-eye, the first satellite within seconds after system turn-on, with dish sizes of 6 and 7.46 meters and HPBWs down to 0.7 degree.

In sizes less than 4 meters/13 feet, it is doubtful whether the ultra accuracy and rigidity offered by the az-el mount designs are worth the extra cost, unless one intends to go after the strong signals from Molnya in the northern sky.

If you plan to work the Ku-band satellites, the az-el mount design becomes very useful; some might say essential. A lovingly assembled 12 foot dish that renders full theoretical gain at 12 gHz has an HPBW of 0.5 degree—one third of the 4 gHz value. the latest ADM and Paraclipse 11 and 112 foot mesh antennas have shown useful potential at Ku-band. The type of perforated or expanded mesh used respectively by ADM and Paraclipse imposes a very small (.1 or .2 dB) gain penalty



AZIMUTH FOR N. HEMISPHERE: 90° 100° 110° 120° 130° 140° 150° 160° 170° 180° 190° 200° 210° 220° 230° 240° 250° 260° 270°
E SE S SW W

AZIMUTH FOR S. HEMISPHERE: 270° 260° 250° 240° 230° 220° 210° 200° 190° 180° 170° 160° 150° 140° 130° 120° 110° 100° 90°
W SW S SE E

TVRO SITE LOCATION PROVIDENTIALES
LATITUDE 22°00' N LONGITUDE 72°01' W
PREPARED FOR ROBERT B COOPER JR
PREPARED BY J K VINES
DATE MAY 23, 1985

FINDEX WORLDWIDE
P.O. BOX 448
MONEE, ILLINOIS 60449-0448
U. S. A.

Consultation
Design
Installation

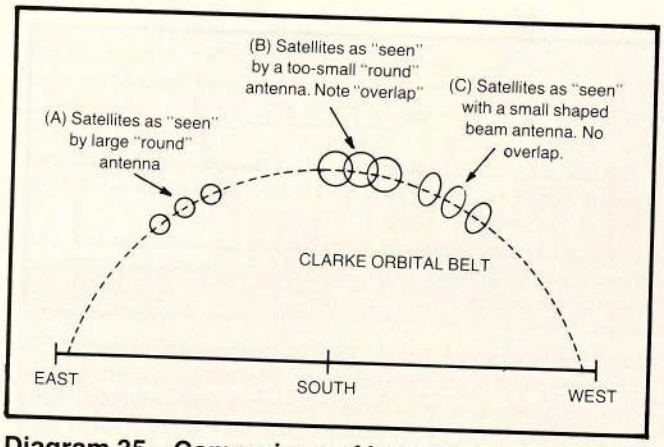


Diagram 35—Comparison of how (A) large conventional antennas, (B) small conventional antennas, and (C) small shaped beam antennas will "see" close-spaced satellites. "Overlap" means adjacent satellite interference. For maximum rejection of interference from adjacent satellites the shaped beam must be kept perpendicular to the Clarke Orbital Bet. The simplest way to maintain "perpendicularity" is to use a polar mount.

Antenna Size	Broadcast Quality EIRP dBw	G/T	CNR
14' Conventional	26	23.5dB/K	6.9 dBwatchable
14' Conventional	22	23.5	2.9 Not Watch
14' Offset	26	25.4	8.8 (*)
14' Offset	22	25.4	4.8 (**)
14' Conventional	34	23.5	14.9 (***)
14' Offset	34	25.4	16.8 (****)

(*)>/= Threshold
(**) Barely Watchable
(***) "CATV Plus"
(****) Broadcast Quality

TABLE 8 - Conventional 14 foot versus 14 foot offset antenna performance. Projected G/T improvement due to offsetting is 1.9 dB/K. With both conventional and offset designs, excellent surface accuracy, careful feed selection and accurate feed alignment are required to achieve the above rather stringent system G/T values. The substitution of an 80 degree K LNA will reduce the system G/T (and receiver CNR) by 0.8 dB (conventional) and about 1.0 dB (offset). The System G/T improvement due to offsetting at this size is roughly equal to upgrading to about 20% larger conventional antenna. At low look angles the improvement is even greater.

at Ku-band. These and other manufacturers with promising antennas would do well to test-market optional Ku-band ready mounts.

Because there is increasing Ku-band activity, there will be a growing market for home TVROs that can work both 4 and 12 gHz satellites. Thus equipped, a very accurately constructed 10 foot dish will be as directional at 12 gHz as a 30 footer at 4 gHz. The wise dealer who plans ahead will be asking many questions about today's breed of mount, improved as it is over the offerings available two or three years ago. As recently as 1983, actuator failures were so frequent that a motorized azimuth-elevation mount (which would require two actuators electrically strapped together under control of a single console) seemed impractical for all but expensive commercial installations.

SITE LONGITUDE RELATIVE TO 60, 75, 90, 105, 120, ETC., DEGREES WEST	HIGH NOON WILL OCCUR AT
−7.5 degrees	11:30 am
−6.0 degrees	11:36 am
−4.5 degrees	11:42 am
−3.0 degrees	11:48 am
−1.5 degrees	11:54 am
+/−0.0 degrees	12:00 noon
+1.5 degrees	12:06 pm
+3.0 degrees	12:12 pm
+4.5 degrees	12:18 pm
+6.0 degrees	12:24 pm
+7.5 degrees	12:30 pm

TABLE 9 - Timing high noon, when shadows point true north.

LATITUDE	DECLINATION ANGLE	TANGENT
0 degrees	0.00 degrees	.0000
5 degrees	0.90 degrees	.0157
10 degrees	1.78 degrees	.0310
15 degrees	2.60 degrees	.0454
20 degrees	3.50 degrees	.0611
25 degrees	4.30 degrees	.0751
30 degrees	5.00 degrees	.0875
35 degrees	5.70 degrees	.0998
40 degrees	6.30 degrees	.1104
45 degrees	6.90 degrees	.1210
50 degrees	7.40 degrees	.1298
55 degrees	7.85 degrees	.1378
60 degrees	8.20 degrees	.1441
70 degrees	8.60 degrees	.1512
80 degrees	8.90 degrees	.1566

TABLE 10 - Declination at due south for latitudes from the Equator to 80 degrees (North or South). As shown in Diagram 35, the declination angles east and west of center decrease slightly.

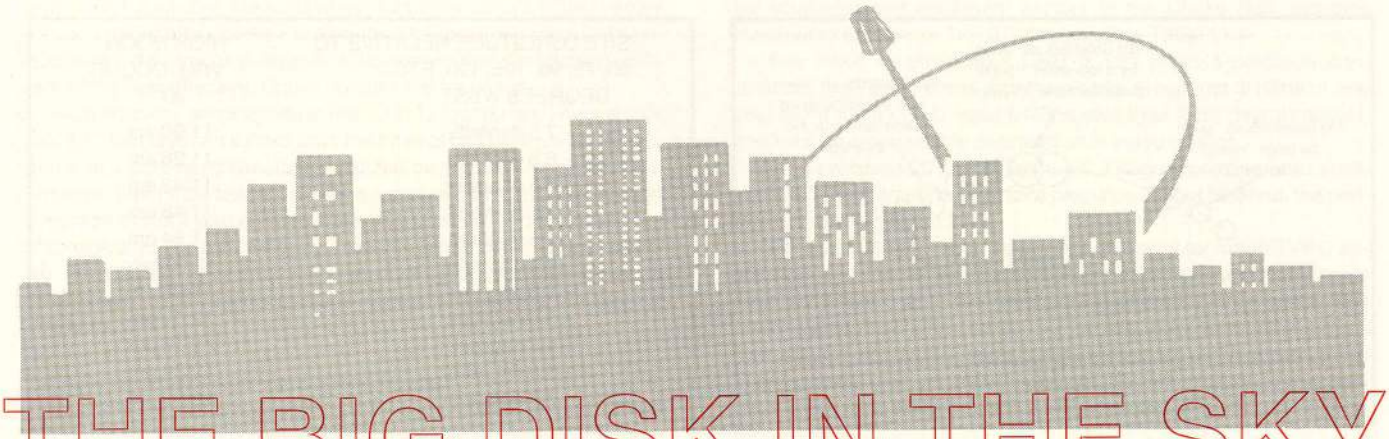
	APPROXIMATE GAIN PENALTY IN DECIBELS		
MIS-AIMING FACTOR	4.88m/16' HPBW 1.1	6.1m/20' HPBW 0.9	7.32m/24' HPBW 0.7
0.2 degrees	0.3 dB	0.5 dB	0.9 dB
0.3 degrees	0.8 dB	1.2 dB	2.0 dB
0.4 degrees	1.7 dB	2.6 dB	3.6 dB
0.5 degrees	2.6 dB	4.0 dB	6.0 dB
0.6 degrees	4.0 dB	6.0 dB	10.0 dB

TABLE 11 - Gain penalty as a function of mis-aiming. As antenna size and gain are increased, the penalty for slight mis-aiming also is increased.

The failure rate as of mid-1986 is substantially lower. Also, a well designed az-el mount would seem to place less stress on each of its actuators.

Will there be a market for dual actuator azimuth-elevation mounts? Are there forward looking antenna OEMs that will create such a market?

FOOTNOTE 5 - An 11 X 7 inch Satellite Coordinate Index, custom-plotted for a radius of 30 miles around your central business location can be obtained for $29.95 (US funds) from Findex Worldwide, PO Box 448, Monee, IL 60449. Included with the customized color-coded plot are 10 additional photocopies.



THE BIG DISK IN THE SKY

By H.R. Walker

A new high speed data system for use over cable systems and on satellites offers a solution to the data speed bottleneck for the providers of VideoTex services. The cost is typically one fourth the cost of a 9,600 baud system, yet data is sent at 250 kilobaud.

Serving the world's thirst for data is becoming an international pastime. The French have the Minitel, a low cost VideoTex unit that is free to those who request it. Canada, England, Germany, Japan, and the US all have VideoTex systems of one form or another. Some, such as Dow-Jones and Compuserve, are successful and some are marginal. In spite of some past failures, nearly every large corporation seems to be betting on VideoTex in one form or another.

The name VideoTex has begun to acquire a tarnished image, and so all the players call it something else. One thing is certain, whatever you call it, it must offer enough services to attract customers. It must also cost very little and be simple to use.

Mr. Joseph L. Dionne, President of McGraw Hill, wants to feed information gathered by his books, magazines, and financial services into a turbine, and then whisk it electronically to his customers. Analysts estimate the market at $10-$12 billion a year now, growing by 20% a year.

The problem is one of distribution. How do you save megabytes of data, update it every time a stock is bought or sold, add in political, technical, and business news, and provide electronic mail at the same time, then send it to millions of subscribers?

McGraw Hill feels the answer is in X-Press, a cable data service that now passes more than 20 million homes. The Financial News Network also passes 20 million homes on cable and has similar ideas. They differ in the means of transmission. Both admit they have technical problems because you can't send enough data at 9600 baud to fulfill the dream.

All providers of the data services seem to be agreeing that they must send more data faster. X-Press, the McGraw Hill-TCI venture, is looking to increase the data rate to 96,000 baud. FNN is stuck, however, because you can't go any faster on a Vertical Blanking Interval system.

There are providers of services on FM-SCA that reach 19.2 kb (Bonneville) and some have announced 38.4 kb systems (Electronic Publishing, Johnson and Pegasus). 38.4 kb hasn't caught on because of intolerable error rates. A second problem is that no one knows what to do with data at that speed.

The obvious answers are: 1) Add a microprocessor buffer, or 2) Tie it into a PC as a data receiver. The first is expensive, the second is more attractive because it ends up on a PC anyway.

FM subcarrier systems are an obvious local area choice. Data can be sent to thousands of receivers from a single station. This approach is being used by Bonneville, Mutual's Multicom, Lotus Dataspeed, Telerate, and several others. Data speeds as high as 38.4 kb can be used.

A narrow bandwidth FM-SCA system was demonstrated in 1985 by Pegasus that requires only 6.4 kHz of bandwidth for 38.4 kb. Using such a system, one 38.4 kb channel and three 19.2 kb channels can be carried by single FM stations at the same time. Because the bandwidths are narrow and Phase Modulation is used, there is no loss of signal. In fact, the signal-to-noise ratio is actually improved over the present FM/FM systems. Digital signal processing, which can be combined with forward error correction greatly improves the error rate.

FM-SCA service is limited using the Pegasus high speed data system by the number of cycles available in a data bit on a subcarrier. At 38.4 kb, there are only five cycles in a bit, which makes error free detection difficult. For this reason a digital signal processor is used with the special narrow band system that achieves a Nyquist factor of six.

Over cable, or by satellite, these restrictions do not apply and the Pegasus system will easily transmit data at 250 kilobaud. At that rate, the data is at disk speeds and a multitude of things become possible.

1) A receiver will be able to emulate a disk.
2) Disk track, sector, and side can become addresses or data categories.
3) PC software can select the equivalent sectors to load.
4) Twenty-six times as much data per unit of time can pass in the turbine.
5) Individual sectors can be edited or updated.
6) Electronic mail becomes possible.
7) Broadcast news is selectable by category.
8) Sixty-five million bytes can be stored in the loop.

Mr. Dionne's concept is viable, but his choice of words is wrong. It is a disk and not a turbine. The master disk spins data all day long, and the individuals who tap the data can be likened to individual read-only heads.

The system uses single sideband phase modulation to cut the bandwidth required in half. It then uses encoded and filtered data to cut the bandwidth in half again. A Nyquist factor of four is achieved.

The Nyquist factor is a measure of system efficiency and is expressed as baud rate per Hertz of bandwidth. Some typical values are:

Baseband NRZ	2
Modulated Carrier	1 (Both Sidebands)
SSB Carrier	2 (One Sideband)
MFM SSB	4 (One Sideband)
Quaternary SSB	4 (Four Phase System)

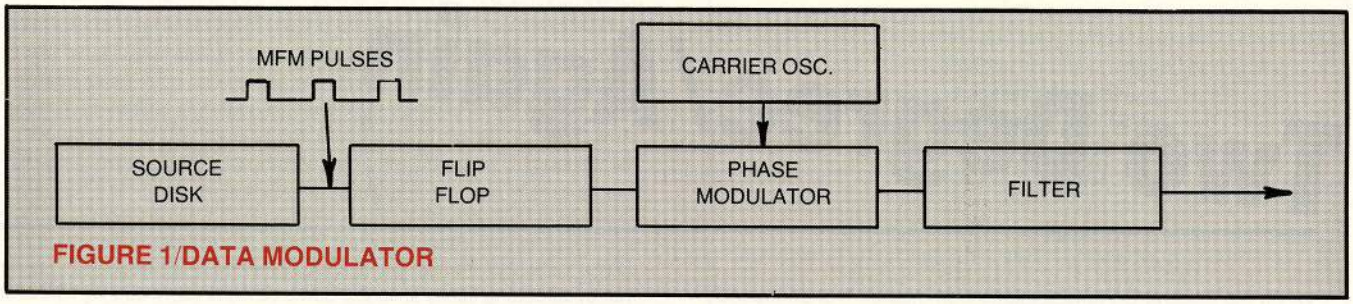


FIGURE 1/DATA MODULATOR

The bandwidth required is only 62.5 kHz. On a cable system, channels can be spaced 200 kHz apart, compared to 400 kHz for FM stations. Using satellites, the subcarrier channel is narrower than those used now for sound. Narrow bandwidth means better signal-to-noise and lower error rates. Obviously, it also means you can squeeze in that many more channels. Figure 1 shows a block diagram of a cable or satellite modulator.

The disk system, which is the source of the data, has as its output a series of pulses which correspond to Miller encoding or MFM, which is standard for all computers utilizing double density disks. These pulses set and reset a flip-flop to create a chain of pulses varying in width and spacing. In terms of the fundamental frequencies involved, the frequencies are 1/2 to 1/4 the baud rate. The standard 250 kb data rate has frequencies of 125 kHz and 62.5 kHz. Since there are no lower frequencies, only those between 62.5 kHz and 125 kHz need to be sent. The phase modulator creates a double sideband signal which is filtered to pass only part of the upper or lower sideband, hence only 1/4 of the spectrum is used.

The filter is unique; it must have a zero phase shift throughout its passband. No such filter exists in the textbooks, and one had to be designed and patented for this purpose.

The receiver shown in Figure 2 is remarkably simple. Its only function is to restore the MFM pulses that are required by a PC to be read as if a disk were present.

A standard FM converter is used along with the special filter described above. Limiters and phase detectors are textbook items that require no further explanation. The output of the phase detector is converted by a one shot into a series of pulses that imitate a disk drive.

An adapter card on the back of an existing disk drive allows the receiver to be read as if it were another drive; drive E, for example.

Since the PC disk operating system reads sectors and tracks as called for, we utilize a special program that will enable us to read any one of 256 tracks, 256 sectors on the track and either of two sides. Of course, these tracks and sectors don't exist. They are only headers in a data stream, but they give us a convenient addressing means. Sector sizes from 128 bytes to 1024 bytes can be used.

Since there are 256 x 256 possible sectors per side, the capacity for side one is 65,536 sectors, or 67.1 million bytes of data.

The system could be used in the following manner. Suppose stock quotes were on Track 1, with sub-categories in sectors 0-255. A monitor program would enable the user to ask for a quote on TEX. The operating system would load the index sector, see that TEX would be in Sector 182, then load sector 182. The program would then sort through the data loaded and display the information on TEX.

A news retrieval system would enable the user to seek out business news in South Africa on metals. The index sector would be loaded first, then the news sectors, which could then be displayed as if a Text Editor were being used.

For electronic mail, side two is available for messages. The program might load an index sector, find the next sector in which the addressee's number would appear, load that sector to get sector adresses for the mail, then load the mail.

In this way, more than 65 thousand addresses can be handled. Since not all will have mail, only the actual mail would be on side two. Security systems can be built into the software so that those who do not possess the unlock code cannot read someone else's mail. This would be necessary if bank or financial statements were to be sent in broadcast fashion.

On a local cable system 65 thousand addresses should cover even the largest of systems. When the system is nationwide, a dual address system would be required—sort of a zip code sorter, followed by the addressee number.

Millions of backyard dishes now receive HBO, Showtime, Disney, etc., much to the displeasure of the program originators. It is quite simple to add a data channel to these systems so that nationwide Electronic Mail service is easily accomplished.

In metropolitan areas, the data can go by satellite to an FM station for retransmission at lower rates. On a multiplexed 4-channel system using the Pegasus high speed system with its data compression feature, the channels would carry (19.2), (19.2), (19.2), (38.4) kb. The equivalent of ten 9600 baud channels are available. This is about 1/3 the capacity of a satellite or cable system operating at 250 kb, but by shedding some services, or using multiple stations, it would probably suffice.

The system described was demonstrated on local cable in March 1986, and in Denver, in April. Tests on a satellite are scheduled soon. Patents have been applied for in the US and Europe.

Mr. Dionne's dream of a turbine, in reality an endless loop of data for the masses, is not a dream; it is here today. The receivers are very inexpensive; so inexpensive that they might be given away with a service package. In fact, collecting the money for the service might well be the hardest part.

The uses for VideoTex, or electronic mail, or electronic publishing, or whatever it is called, are just beginning to be found. Do you want a job in Wichita, or a wife to live in Alaska? Just type it in and wait until the information goes by.

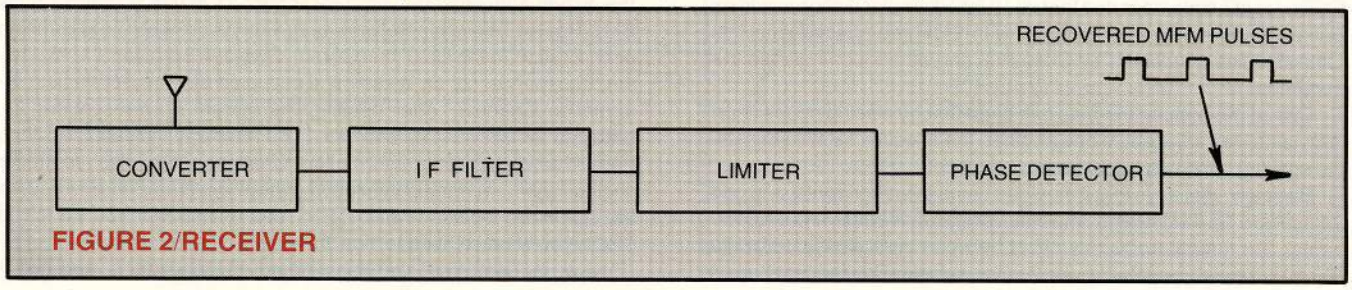


FIGURE 2/RECEIVER

Two Degree/Again

When the Federal Communications Commission first announced its intention to require all C-band satellites to move closer together, to locations but 2 degrees apart in the sky, there were howls of protest from a wide variety of satellite system users. Two groups seemed to have valid points concerning the move; those using small dishes (under 10 to 12 foot in diameter) and those involved in uplinking from transportable, typically smaller-dish systems. The original Commission plan was to place all satellites 2 degrees apart and not to be concerned about the individual satellite polarization schemes; in theory, a Westar and a Galaxy bird could be placed adjacent, 2 degrees apart, even though both share a common polarization format (i.e. odd number is horizontal, even number is vertical). Then after additional study, the commission decided to revise that plan and require that adjacent satellites maintain opposite polarization schemes such as we now have between Galaxy and RCA's F3R for example. However, there would be opportunities for interference because there would be an interim adjustment period during which those satellites now in orbit would be allowed to live out their useful life before being replaced with newer satellites created for the 2 degree spacing.

At the present time, the existing satellites are spaced variously from 2.5 degrees apart to 5 degrees apart. We have lived with satellites spaced in the 4 to 5 degree separation range since we first began selling home dish systems. Generally speaking, such spacings have created very few problems for us.

The principal problem with closer satellite spacings is the width of our receive antenna beamwidth. Think of the antenna beamwidth as an opening in a funnel. If the funnel has a wide flare and you use the narrowed end as a siting instrument, through the wide end you will see a considerable expanse. If on the other hand the flare of the funnel is narrow and the sides are steep, your field of view from the narrowed end will be reduced in width.

This field of view or beamwidth of a dish depends to some small extent on the design (f/D) of the dish, to a larger extent on the design of the feed, and most of all on the diameter or size of the dish proper. As a rule of thumb, larger dishes have narrower beamwidths and smaller dishes have larger beamwidths. It happens that if you compute the beamwidths on paper, using graph paper or math, you find that a dish that is between 8 and 10 feet in diameter begins to have problems with satellites spaced 2 degrees apart; simply because when the dish is pointed at a single satellite, its wide beamwidth is also picking up some measurable amount of signal from the adjacent satellite(s) as well.

Studies completed as far back as four years ago were often (usually) at odds with one another. A study by Microdyne (published in CSD), for example, reported that all 10 foot diameter dishes would experience some degree of difficulty with 2 degree spaced satellites. Other studies conducted by Chaparral and others contradicted that statement.

One of the popular theories has been that by placing opposite polarity satellites adjacent to one another, the effective satellite to satellite spacing becomes twice the real distance.

Basically, that says that if satellites using even/horizontal and odd/vertical are stacked next to satellites using even/vertical and odd/horizontal, the natural frequency offset between vertical and horizontal (20 mHz typically) will further isolate the signals. The concept here is that by offsetting 20 mHz on the same satellite (between vertical and horizontal) we have sufficient separation or isolation to maintain essentially interference free service of all 24 channels from a single satellite. So if you can do that within a single satellite, why can't you also do it with the same or better results between two adjacent satellites separated by 2 degrees?

This planning was based upon all satellites following essentially the same design, or a frequency-use format first created by RCA with their F1 (24 channel) satellite in 1973. Unfortunately, this is not the case in the real world and you can see this problem yourself from virtually anyplace you may live within direct line of sight to the western portion of the North American belt.

Our example will be the 3 degree spacing between GTE Spacenet 1 and the Westar 5 satellite; 120 and 123 degrees (west) respectively. The first variable has to do with your location. Keep in mind that the satellites are spaced 2, 3, or 4 degrees apart only from the perspective of your viewing point. If you were located at 121.5 degrees west, then Spacenet would appear at a point 1.5 degrees east of due south and Westar would appear at a point 1.5 degrees west of due south. However, if you are located at 100.5 west, both of the satellites appear around to your southwest. Notice that as you go further east (or west) than the satellite's actual location, the angular separation or distance between the two satellites closes up. This is an important point and it means that as your receiving location moves closer to the equator and further east or west from the actual longitude of the satellite(s), the apparent separation between the satellites gets tighter. In effect, what was 3 degrees of spacing becomes closer to 2 degrees of spacing. Those satellites that are actually two degrees apart in the future will be less than two degrees, except when they are nearly due south of you. And this hurts.

Westar 5 follows the original RCA format of 24 transponders; 12 vertical and 12 horizontal. It is cross-polarized from the RCA birds, with odd channels horizontal and even channels vertical. Three degrees to the east we have Spacenet 1 and it has its own type of frequency allocation scheme.

On Spacenet there are 12 horizontal transponders (odd numbers such as TRs 1, 3, etc.). These are the most frequently used transponders on Spacenet (TR17 is home for Satellite Showtime and Boresight). Right next door, 3 degrees away, there are 12 vertically polarized transponders on Westar 5. You can use this situation to evaluate the apparent resolving ability of your dish antenna system.

TEST

In your test system, first set up for horizontal polarization and run the dish to 120 west. Dial up transponder 21 where you should find BTN (Baptist Television Network) with either scrambled programming or an ID slide 'in the clear' (see photo). Between 8 pm and 11 pm eastern, transponder 22 on Westar 5 is occupied by 'The Scrambling Information Channel.' After peaking the system on transponder 21, switch to transponder 22 and see if you have any indication of video from 'The Scrambling Information Channel.' The dish controller should have a manual polarization control system or an override on the automatic polarity switching for this test. When you switch to TR21, you will also need to 'flop' the polarization to vertical.

Now, the test. With the dish peaked on Spacenet 1, and polar-

ization set to horizontal, you are receiving BTN on TR21. If you switch polarization to vertical but leave the antenna alone, you are checking to see what signal pickup there may be from the Westar 5 bird some 3 degrees away. You can do this with these two transponders because there is no vertical signal on Spacenet on transponder 21 or 22.

Suppose you do this and see some sort of signal on TR22, from Westar 5; what then? First, be certain your polarizer is properly adjusted for minimum cross pole; i.e. the signal you are seeing should not be coming from the BTN signal on horizontal polarization because the polarization switcher is slightly skewed. Verify this ahead of the check described here. If there is definite signal from W5 with the dish in the S1 position, you know that with 3 degree spacing your dish is unable to separate satellites.

Now reverse the situation; take the dish to W5 and TR22 and peak on 'The Scrambling Information Channel.' Then switch to TR21 and flop the polarization to see if there is any sign of the BTN programming. The fact that BTN carries an off-hours static ID slide makes it very easy to read even when it is quite weak and that helps you be sure in this test that the stray signal you are receiving is in fact from Spacenet 1. There should be no horizontal signal on TR21 of Westar 5 at this point (this is not a regularly used channel; a reason for the particular channel groups selected for this test).

If you can approach the test by being peaked on either W5 or S1, and see some indication of the presence of the other (undesired, non-boresighted) bird, here is what we now know:

1) The dish is symmetrical, that is, it has a broad pattern on both sides (from S1 towards W5, and from W5 towards S1). If you see S1 when pointed at W5 BUT do not see W5 when pointed at S1, that also tells you something; that the dish has a squashed forward pattern on one side (see diagram). You can use this knowledge to readjust or replace the dish feed.

2) You could actually measure the beamwidth of the dish, although you may not have the required test equipment. Here's how.

A) First estimate or measure the Carrier-to-Noise Ratio of the BTN and/or 'Scrambling Information Channel' signals. If you have a 10 foot dish and a typical LNA, it will be between 7 dB CNR (some noise) and perhaps 11 dB CNR (no noise, very clean) at virtually all US locations.

B) Now estimate or measure the CNR of the non-desired signal when you are pointed at 'the other' satellite. This will be someplace between O dB CNR (just a hint of a signal, drifting frame bar) and 7 dB CNR (some noise). A hint; if the color is showing but right on the edge of snapping in and out, the CNR is between 3 and 4 dB.

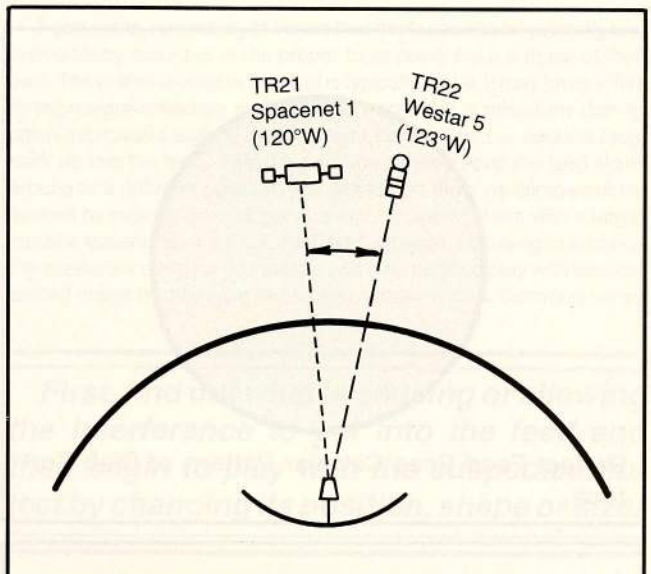
C) Now you have a ratio; the CNR of the signal when you are pointed at the desired bird (call it 10 dB) and the CNR of the signal when you are pointed at the non-desired bird (call it 4 dB). That is 10 dB to 4 dB or a 6 dB difference. That 6 dB is the amount of gain reduction your dish exhibits when it is pointed 3 degrees (or less; remember your slanted-look-angle to the two satellites) off of or away from a desired bird. That number will hold true for you regardless of where the dish points in the sky.

If it happens that the dish has a squashed pattern, interference between satellites when the dish is pointed at S1 for example but not when pointed at W5, this becomes valuable information for you to correct the dish or feed or both. Let's see why this is so.

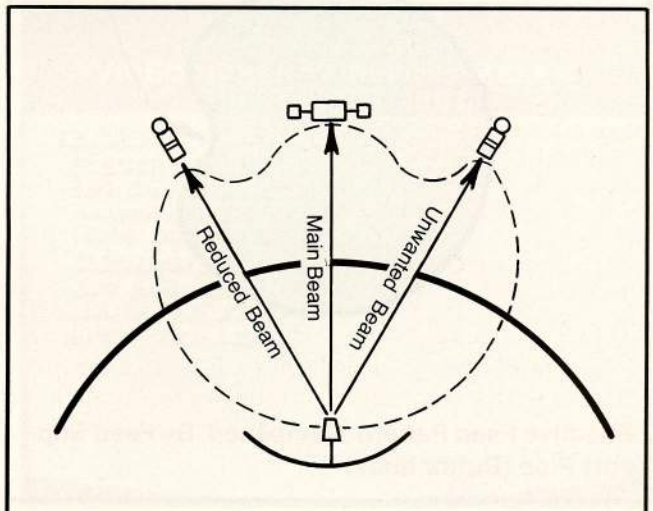
Uneven Pattern

A perfectly symmetrical dish (fully parabolic) and a perfectly symmetrical feed (fully circular in form) will produce an antenna pattern which is equal in all directions. There are few such antenna systems in existence; all have some anomalies. Most often, the buttonhook feed support, the guy wires on the feed, or the struts that help support the feed interact with the feed system creating bubbles or discontinuities in the antenna pattern. This can produce a bump on the antenna pattern on one side or another. You can often correct or move the bump around by rotating the buttonhook on its own axis, moving the three or four guy wire supports (equally) another 20 to 30 degrees around the dish, or if the feed is held in place with feed struts (such as some of the ADM antennas), reposition the feed struts by rotating them 20 to 30 degrees around the dish. Ideally, no guy wires or feed struts should be located to the dish surface between 11 and 1 o'clock, 2 and 4 o'clock, 5 and 7 o'clock, or 8 and 10 o'clock. That doesn't leave many holes (it leaves 1-2, 4-5, 7-8, and 10-11) for the struts or guy wires; keeping the metallic surfaces out of the danger areas will help reduce the likelihood that signal reflections from these metal parts may distort the antenna's pattern for either vertical or horizontal polarized signals.

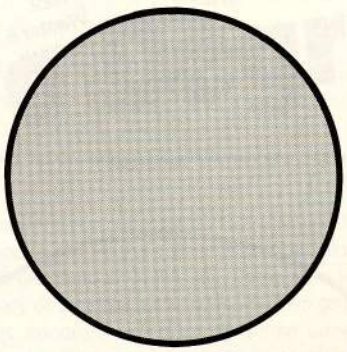
Then there is the probability that the dish itself may not be parabolic in shape (although it is supposed to be). If the dish itself is distorted, warped or not true, it will not focus all of the energy it receives to a



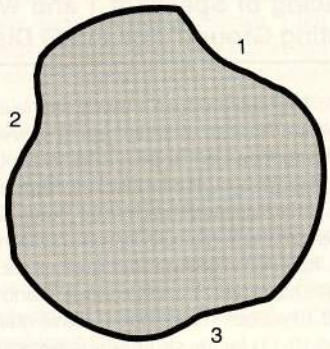
Close Spacing of Spacenet 1 and Westar 5 Provides 'Testing Ground' For TVRO Dishes.



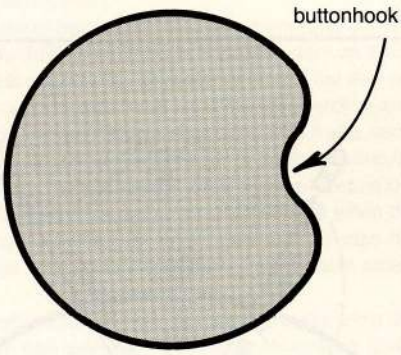
Effects Of Mis-Shaped Beam Pattern On Contorted Dish.



Perfect Feed Sees Circular Pattern of Dish Surface



Distorted Pattern Of Feed Caused By 3 Struts Supporting Feed



Effective Feed Pattern 'Dampened' By Feed Support Pipe (Buttonhook)

Pattern Created By Feed Is Modified By The Feed Support Structure.

single point. The point, in front of the dish, is the proper location for the feed of course. If the dish is physically distorted, the normal razor-sharp focal point becomes blurred, ill defined as a point, and you may find the feed focuses rather broadly. That is a sure sign that the dish (plus feed) is not functioning as intended and the feed system may be producing a broader forward pattern than it should. If the feed does not focus properly (i.e. sharply), you must determine why (and where) the dish is distorted before you can attempt to measure or correct problems related to the feed or feed supports/struts. Unless the dish reflector is properly shaped, the dish feed cannot be made to function as designed.

There are numerous techniques for verifying that a dish is operating properly, and for checking the integrity of a dish. One of the easiest systems is to 'string' the dish; run taut strings from one side of the dish to the other, from say 12 o'clock to 6 o'clock, from 3 o'clock to 9 o'clock. The strings will cross one another in the center of the dish. The center of the dish (strings crossing) should also be the spot where the center of the feed is located (see diagram). That's an easy test to conduct. The test becomes more meaningful if you also cross additional strings from 2 o'clock to 8 o'clock and 4 o'clock to 10 o'clock. Now you have 8 points on the dish (opposite ends of all four strings) which should all cross at one common, central point in the center of the dish. If the strings do not cross one on top of another, there is a distortion in the dish surface causing one or more strings to pull off of center. Additional strings (1 o'clock to 7 o'clock, etc.) will improve the accuracy of the measurement.

Stringing the dish, before you attempt to install or center the feed, will give you an opportunity to readjust the dish for proper shape. A dish that uses an outside banding ring, such as the larger ADM 20 foot for example, can be nudged into shape by simply loosening the outer band rings and then gently prodding the bands to slide about so that the dish comes closer and closer to being a true parabolic shape. When all of the strings cross at the same (center) point, you have a true parabola. Other dishes such as the Paraclipse series may require loosening of the back supports as they attach to the dish hub and tapping the support struts to gently move them about while there is still some modest amount of bolt pressure on the antenna itself.

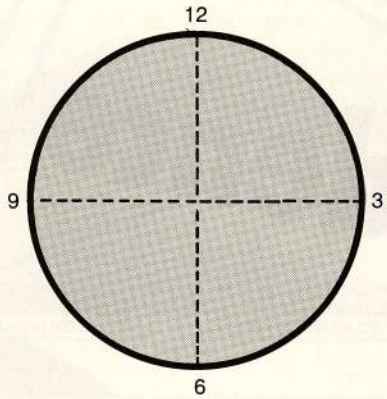
Remember, if the dish is not symetrical, if the shape is not parabolic, then all bets are off concerning the ability of the feed to create both maximum gain and cleanest sidelobe patterns.

TI Enhancement

A dish that has poor rejection in the Spacenet 1 vs. Westar 5 test will also have a higher degree of susceptibility to TI (terrestrial interference) as well as to Earth noise sources. In other words, by performing the S1 vs. W5 test, you can do some rough grading of various antenna systems you may be using as a dealer for consumer installations.

Here's why. When the dish has a squashed pattern that you can see, you can measure the presence of S1 (or W5) on one side of the dish but not the opposite side, you are then aware that someplace out there in space, the antenna system has a sidelobe which is intercepting energy coming to the dish from some direction (or directions) other than dead ahead (i.e. boresight). If the antenna system is susceptible to energy from a satellite spaced 3 degrees off of boresight, it is probably also susceptible to energy coming from other sideways directions. Sideways means up and down as well as left and right since the dish itself is round in shape.

TI signals come towards the feed from the side (through the air), from below (bouncing off the ground), and from above (bouncing from trees and buildings). It is dangerous to use a dish that reacts to these off-boresight signals. Earth noise, from the ground itself or from high



Run Taut Strings Across Dish From Opposing Sides; 3 Or More Strings Crossing At Same Point Locate Dish Center.

level noise sources such as a building or trees, also causes you unusual problems because this earth noise is an unwanted signal source in the 300 degree and higher Kelvin region. Such a noise source will add noise to the reception, just as a noisy LNA will add noise. If the antenna plus feed is responsive to such signals, because of a distortion in the antenna pattern, your signal or system performance is degraded and you will have an almost impossible task of tracing why it is happening. The solution is to clean up the antenna pattern, which comes back to first verifying the shape of the dish and then verifying the pattern of the feed plus dish.

A piece of aluminum foil or a piece of aluminum sheet, approximately 12 inches square, can be a troubleshooting tool. Mount it on the end of a (broom) stick and it becomes a portable wand to wave or move in front of the feed from various side angles. With the metallic shield on a stick, in a TI or high noise situation, arrange a monitor so you can see (or an assistant can see) what happens as you move the flat plate wand around close to the feed but not in front of it (i.e. not between the opening of the feed and the dish surface). By holding the plate first to one side and then the other, the bottom and the top of the feed, you will find that when the shield falls between the TI noise or interference source, the plate will block the undesired signal from crawling into the feed opening. The picture will clear up. That tells you the direction of the interference. If the interference is very strong, you may reduce but not elimnate the problem. If the interference is sneaking through the dish proper (a screen mesh dish) from the rear, directly into the feed, you cannot block it with a test shield off to one side of the feed. Finally, if the interference is from the front of the dish and is being reflected by the dish itself back into the feed (rather than coming directly to the feed through the air), the plate will only have a minimal (or no) effect on the TI.

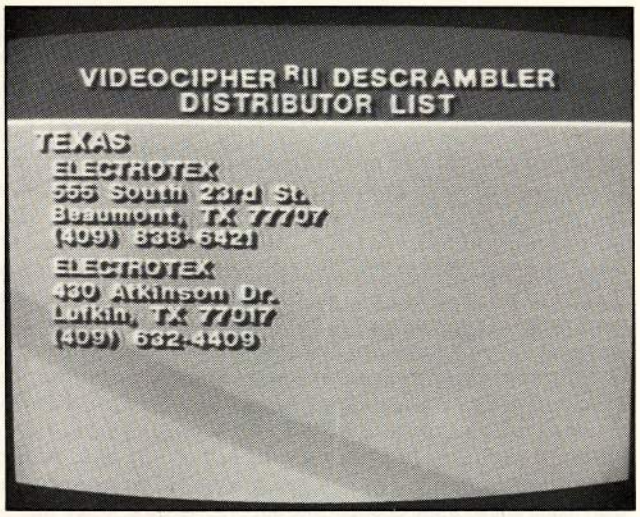
The simplicity of such a testing tool is a weakness with some types of interference, but for many situations you can save yourself valuable time by pinpointing the direction of the problem. It will also help you re-evaluate the possible relationship between a distorted dish surface and a TI or Earth noise source. You may find that a metal guy wire or a feed strut is the culprit and by placing the moveable shield in line between the metal guy/strut and the feed opening it clears up. That tells you that you need to move a support around or change its shape to redirect the reflected energy getting into the feed.

Feed struts, necessary to insure that the feeds can be properly and permanently mounted at the proper focal point, have a mass of their own. The material used in the strut is typically metal, it may have a 'flat' or microware-reflective surface which acts like a miniature dish to catch microwave signals in the air and then redirect or bounce them back up into the feed. Sometimes if you cannot move the feed struts around to a different position, you can distort them as microwave reflectors by making them larger or simply wrapping them with a larger metallic material such as foil. First, find out what is causing or allowing the interference to get into the feed and then begin to play with the suspected object by changing its position, shape or size. Common sense

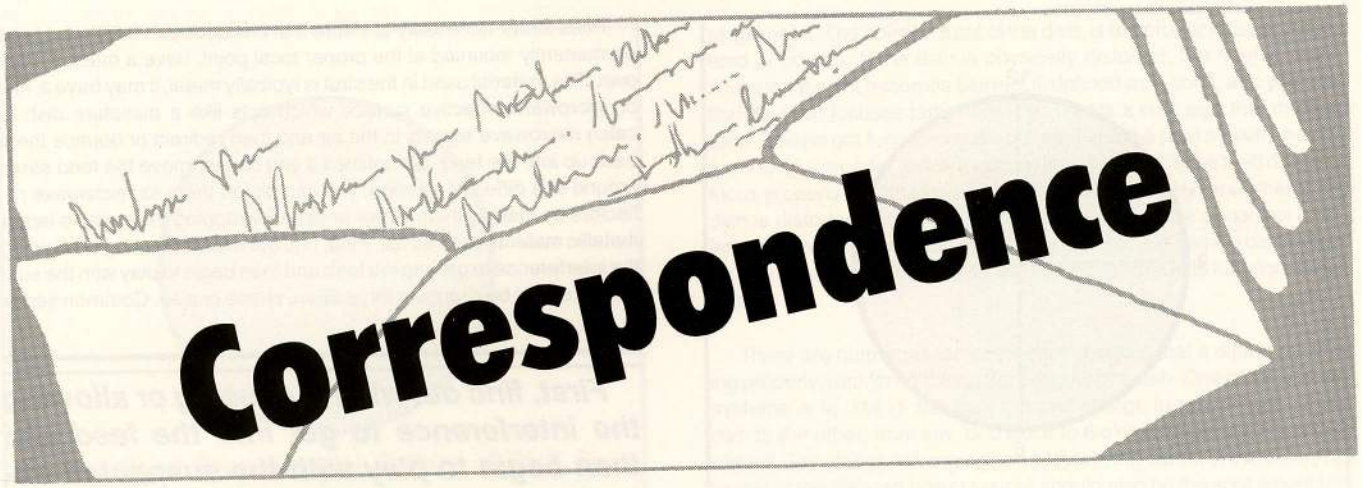
First, find out what is causing or allowing the interference to get into the feed and then begin to play with the suspected object by changing its position, shape or size.

will go a long way to solve such problems; think of the microwave energy as a beam of light, and visualize the pieces and parts of the antenna (and support system) as mirrors. If the light (microwave energy) strikes the mirror (metal parts), where will it go after striking the mirror? If logic tells you some of it will reflect back towards the feed, you need to 'change that flight path to keep it away from the feed' if you wish to avoid interference. It is just that simple.

Common sense will go a long way to solve such problems; think of the microwave energy as a beam of light, and visualize the pieces and parts of the antenna (and support system) as mirrors.



THE SCRAMBLING CHANNEL/ appearing 8-11 pm (eastern) on TR22 of Westar 5 is vertically polarized. It shares virtually an identical frequency to Spacenet TR21, where the Baptist Television Network operates. The birds are 3 degrees apart (see text).



BSS They Say

We at Hughes Communications, Inc., want to provide the (home) TVRO industry with certain information which may be of assistance in the design and planning for Ku-band receiving equipment. As most are probably aware, Ku-band satellites may be in either the Fixed Satellite Service band (FSS) or the Broadcast Satellite Service band (BSS). Hughes Communications will be launching satellites for delivery of video programming to the home in the BSS band. We intend to keep everyone informed as early as possible about our system and to keep issuing progress reports as well. The basic information concerning the BSS system is attached. This will help receiving equipment suppliers focus on the necessary technical parameters of the forthcoming system. Anyone requiring additional information should contact us directly.

Daniel M. Zinn
Hughes Communications, Inc.
PO Box 92424
Los Angeles, CA 90009
(213)607-4000

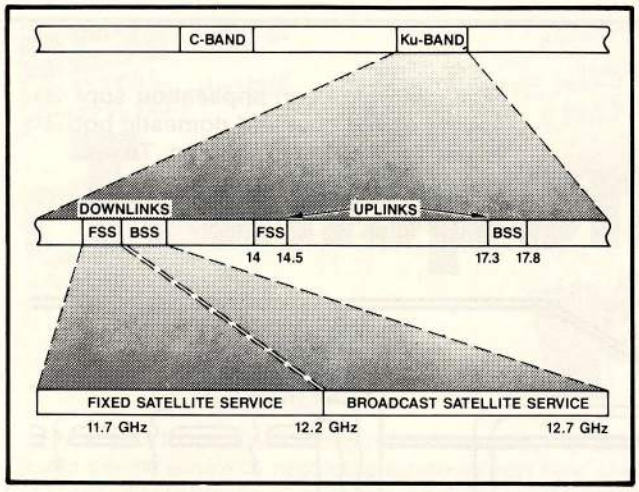
The downlink frequency band is 11.7 to 12.2 gHz for FSS while the downlink band for BSS is 12.2 to 12.7 gHz. A diagram here shows the two bands and their respective uplink frequencies. Hughes anticipates consumers will use dishes 2 feet in diameter, and the twin birds will be located at 101 west with an expected launch date of June 1989. Channels will be transmitted using RHCP (right hand circular polarization) or LHCP. All 16 channels on board the DBS-1 bird will be RHCP while all 16 on DBS-2 will be LHCP. With all the birds co-located at 101 west, the effect will be to have 32 channels at 101 west; antennas on the ground will select between the RHCP and LHCP signals much as we now select between vertical and horizontal. Two separate satellites will be used because the bird size plus the battery life would be compromised if everything had to fit into a single bird-container. The bandwidth of the individual transponders will be 24 mHz with the following roll-off characteristics within a 24 mHz wide channel; +/−10 mHz = 0.9 dB; +/−11 mHz = 1.6 dB; and +/−12 mHz (edge of transponder) = 3.5 dB. The filters are typically elliptic in design. The gain slope within a transponder will be: +/−10 mHz = 0.5 dB; +/−11 mHz = 1.0 dB and +/−12 mHz = 3.2 dB. The group delay within a channel will be: +/−10 mHz = 33 ns; +/−11 mHz = 53 ns; +/−12 mHz = 98 ns. The full transponder frequency assignment plan follows.

HUGHES COMMUNICATIONS
DBS-1 and DBS-2

FREQUENCY PLAN

TR#:*	TR# :**	POL.	UPLINK	DOWNLINK
1	1	RHCP	17.32400	12.22400 gHz
2	17	LHCP	17.33858	12.23858 gHz
3	2	RHCP	17.35316	12.25316 gHz
4	18	LHCP	17.36774	12.26774 gHz
5	3	RHCP	17.38232	12.28232 gHz
6	19	LHCP	17.39690	12.29690 gHz
7	4	RHCP	17.41148	12.31148 gHz
8	20	LHCP	17.42606	12.32606 gHz
9	5	RHCP	17.44064	12.34064 gHz
10	21	LHCP	17.45522	12.35522 gHz
11	6	RHCP	17.46980	12.36980 gHz
12	22	LHCP	17.48438	12.38438 gHz
13	7	RHCP	17.49896	12.39896 gHz
14	23	LHCP	17.51354	12.41354 gHz
15	8	RHCP	17.52812	12.42812 gHz
16	24	LHCP	17.54270	12.44270 gHz
17	9	RHCP	17.55728	12.45728 gHz
18	25	LHCP	17.57186	12.47186 gHz
19	10	RHCP	17.58644	12.48644 gHz
20	26	LHCP	17.60102	12.50102 gHz
21	11	RHCP	17.61560	12.51560 gHz
22	27	LHCP	17.63018	12.53018 gHz
23	12	RHCP	17.64476	12.54476 gHz
24	28	LHCP	17.65934	12.55934 gHz
25	13	RHCP	17.67392	12.57392 gHz
26	29	LHCP	17.68850	12.58850 gHz
27	14	RHCP	17.70308	12.60308 gHz
28	30	LHCP	17.71766	12.61766 gHz
29	15	RHCP	17.73224	12.63224 gHz
30	31	LHCP	17.74682	12.64682 gHz
31	16	RHCP	17.76140	12.66140 gHz
32	32	LHCP	17.77598	12.67598 gHz

*Per FCC Plan
**Proposed Transponder Plan



USCI Gear

I am puzzled as to what to do with my USCI equipment. When they went out of business, they left the equipment which the customer had purchased behind. Can this equipment be aimed at another bird? Please let me know if there is any use for this equipment and whether it can be modified to do something again.

William Cox
7921 Thouron Avenue
Philadelphia, PA 19150

USCI equipment would be capable of receiving the RCA Ku-1 or Ku-2 transmissions (even given the relatively inefficient antenna and feed systems they typically used), but the audio portion must be modified since the USCI service used an audio subcarrier virtually unique to themselves. A skilled TVRO technician could go inside the receiver and modify the audio tuner for 6.2 or 6.8 mHz to recover the audio. Another approach would be to add in an outboard audio (tunable) demodulator from somebody such as USS, Arunta, Drake, or Avcom. Is there a firm out there doing this sort of work? We will gladly publish their name and address as a reference to others.

Who's On First?

As you are aware, the current advertising campaign by Satellite Technology Services, Inc., presents claims regarding the company's so-called firsts. I would like to point out that while certain statements in the ad are absolutely true, they only tell part of the story.

The fact is "the first functioning microprocessor actuator control" was designed and manufactured by Luxor. "The first full function wireless remote control" was designed and manufactured by Luxor. "The first receiver to offer stereo with all modes accessible via direct access " was also designed and manufactured by Luxor.

STS "introduced" these products because it was Luxor's original US distributor.

We bring this to the reader's attention because it is important for people to have a full and accurate understanding of the caliber of Luxor innovation and engineering, and to be aware of the contributions Luxor has made to the state-of-the-art of satellite television receiving systems.

Hans Giner, President
Luxor (North America) Corp.
PO Box 32
Bellevue, WA 98009

As we said in our May 15th issue, the legal tussles between Luxor and STS continue. The argument here is between who 'created' a certain circuit (such as the full function wireless remote control) and who 'introduced it.' Luxor claims they designed and created it, but with STS as their sole US distributor, honors went to STS for the 'marketplace introduction.' The STS advertising, worries Luxor, suggests to the reader that STS 'designed' and 'introduced' the products.

Another Way Around Scrambling

I recently completed reading Coop's article in *Home Satellite TV* describing the status of scrambling. A partial solution has occurred to me after seeing products such as 'The Black Box Solution' and Keith Anderson's video-only descrambler at the Las Vegas show.

For my own use, to view scrambled TV, I could simply resubscribe to Cox Cable TV which continues to scramble HBO video (for example) but not the audio. In that way, a person could use the cable service for audio and his dish for the video.

History repeats. During World War II, something called "Ultra" was formed to break the German military and naval codes. Suppose you took a two track tape deck and recorded the unscrambled digital audio on one track and the scrambled digital audio on a second track, in real time. Then by comparing the two tracks directly on a scope display, you might be able to visually discern the codes being used to encrypt the audio.

Ellsworth O. Johnson
EM Johnson Electronics
364 Couerdalene Street
Spokane, WA 99204

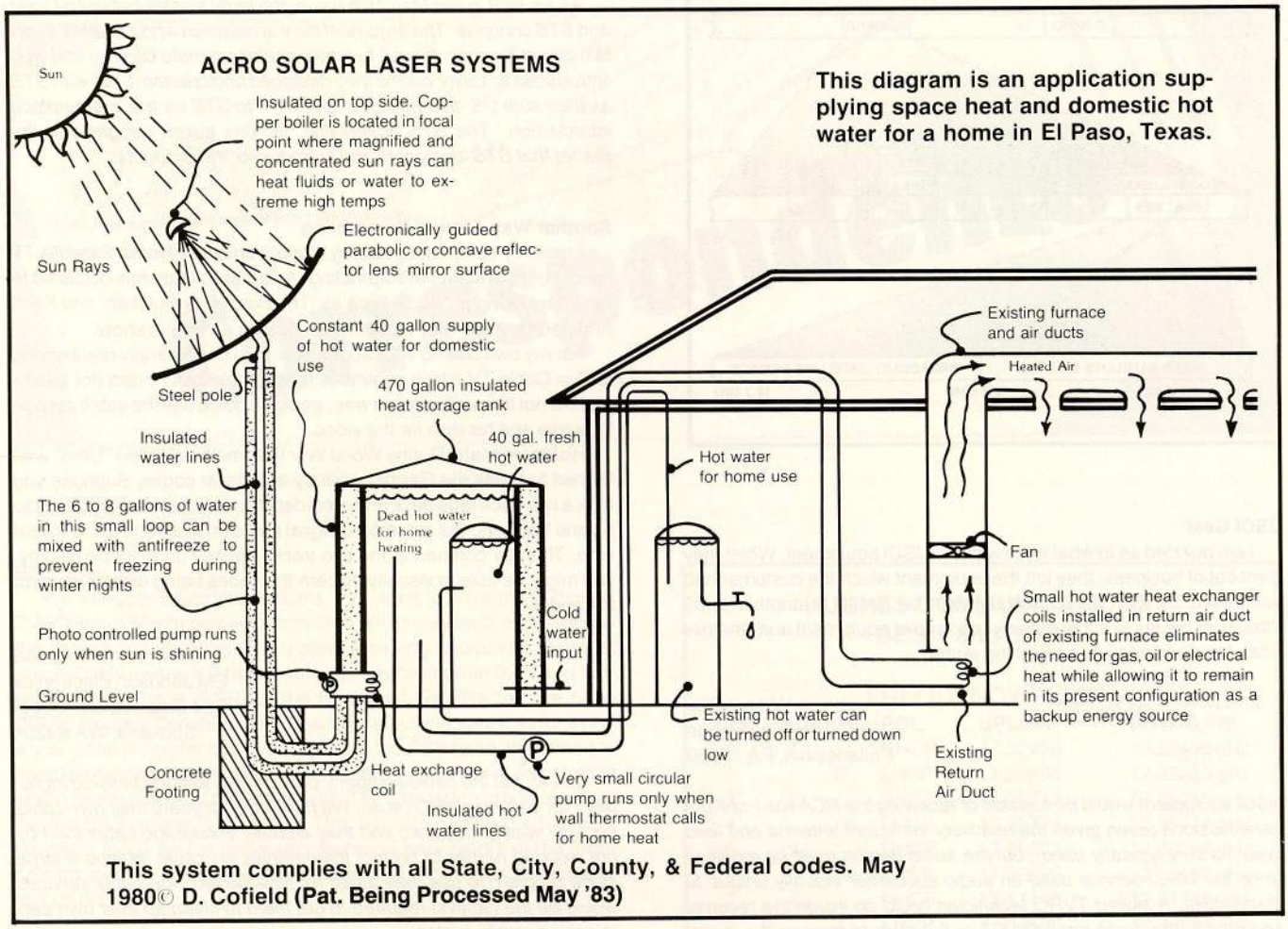
Clever. Let the cable company provide you with the missing ingredient for watching HBO (et al). We have said for years their own cable security was far too soft, and they actually encourage cable theft by not working harder to protect their signals on cable. Maybe a large scale program to use their audio for satellite fed video only services would be the catalyst required to get them to clean up their own permissive security systems.

Three Too Many?

I bought three VC2000 descramblers for my own private use in my home, since I own more than one satellite receiver. I didn't like being forced to have a descrambler for each receiver but I went ahead and did it anyhow. Everything was okay until I called HBO for authorization for the third unit. They refused to authorize it, telling me that their computer showed I already owned two units at the same address, and they have a policy which allows only two units at a single address. Now, come on HBO; what kind of foolishness is this?

John Tutt
Telluride, Colorado

Indeed. One supposes that they have such a policy because they fear that an individual might be acting as a wholesaler of services out of a home, and hauling the units to some commercial establishments after authorizing them. We heard of a fellow in Texas with 14 satellite receivers in his home, and he wanted a descrambler for each receiver. He had to convince HBO that he was not acting as an authorization center for units intended for commercial use elsewhere. M/A-Com seems disinterested in the problems presented by those installations that have two or more consumer receivers tied to the same antenna system. The fact that each receiver must have a descrambler certainly makes the sale-ability of multiple receiver systems tougher. What's the good of having two receivers if you can only decode a single service at a time with one descrambler? Anybody listening at M/A-Com?



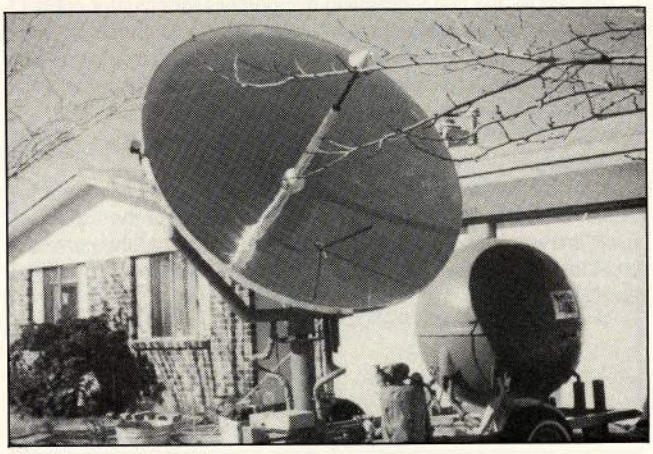
Complete ARCO Solar Laser System package.

Another Use For Dishes?

While I by no means forecast the end to home TVRO, in these times of reduced consumer acceptance of a dish, there are opportunities for the creative TVRO dealer to find other ways of justifying a dish for a backyard. I ran across a system in use in El Paso, Texas which is intriguing; it uses a parabolic dish to collect energy from the sun; that energy can then heat a home, a swimming pool, or produce energy with a steam turbine system. Similar concepts have been used for decades with flat plate collectors, principally used for heating water for household consumption. The claimed advantage of the parabolic system is that the efficiency of the system drops only a few percent in colder weather while with a flat plate collector, it may drop off by nearly 90 percent.

Ellsworth Johnson
EM Johnson Electronics
364 Couerdalene Street
Spokane, WA 99204

The system Ellsworth describes is diagrammed here, from a brochure produced by the manufacturer. Temperatures of several thousand degrees are created with the system. It is far hotter than with typical flat plate collectors. The extreme heat presents some safety problems, but the benefits include longer storage of heated liquids or solids, and far higher efficiencies. Very few parabolic solar heating systems have been sold to date; hundreds of thousands of the flat plate variety have been sold. A device called a Cofield-Lawton Heat Engine can be fitted to the system to generate electricity, pump water, operate refrigeration systems, and so on. There still remains great potential for harnessing the sun's rays, and technology is still very young in that area. One dealer in such equipment is ACRO Solar Laser Systems, 2817 Roy Place, El Paso, Texas 79935 (915/598-8902). There is very little truth to the story that HBO plans to 'scramble the sun's rays in 1988.'



Transponder Watch

PANAMSAT broke ice in finding international partner for its proposed satellite service by negotiating agreement with Peru. Under FCC and other (international) guidelines, for an international satellite supplier such as PanAmSat to go into operation, it must negotiate landing or service rights with at least one foreign country. Intelsat has attempted to coerce all nations into not doing business with firm but Peru broke ice and others are likely to follow.

WESTAR 6 and Palapa B2, two birds which were initially lost in space when their launch sequence from Shuttle failed and then retrieved by subsequent Shuttle mission have finally been sold for $50M (US). The satellites originally cost around $35M each and insurance coverage paid $5M for Shuttle retrieval and $5.5M for retrofitting and repairs. Insurance carriers therefore lost about $30.5M plus on deal. Buyers have not announced their plans for birds.

INTELSAT Director General Richard Colino has apparently gone against wishes of Board of Governors and opposed coordination of Israeli domestic communications system. Israel wants to launch own system but Intelsat approval is required.

TESTING of vehicular location system, designed to allow triangulation of individual vehicles (cars, planes, trucks, box cars) to within yards of true location will begin soon following successful deployment of GTE G-Star 2 bird. On board is prototype location system called Link One which will be tested with approximately 12,000 vehicles equipped with special transponder-transmitters similar in concept to aircraft DME and ADF systems. M/A-Com reportedly has contract with Sony for transmitters.

BIRDVIEW system dealers running extensive advertising highlighting scrambling confusion ("Scrambled Signals?") and offering free descrambler when consumer buys a Birdview (TVRO) system. Advertisement ends with phrase "Let Birdview unscramble those scrambled signals."

TRANS-PACIFIC satellite communications system, to be operated by firm calling itself Columbia Communications, is subject of recent filing with FCC. Firm proposes service separate from Intelsat with single bird at 165 west. Satellite would be Ku-band only, have 44 transponders (RHCP and LHCP) on board and offer for sale or lease transponder space on uncommon carrier basis.

NEXT expendable launch vehicles scheduled for August 14 (Delta 180) with defense package on board. Follow-up expendable launches are October 9 (GOES-H weather satellite) and November 6 (US Navy FLTSATCOM-G bird). With Shuttle shut down, no other US launches from Cape are scheduled for this year.

SHUTTLE would end all commercial and foreign customer launching by 1988 under one plan currently under review by Department of Transportation. All launches after cut-off point would shift to yet-nonexistent ELV (expendable launch vehicles) rockets which government believes should be operated by private sector rather than NASA or US government.

INMARSAT testing 10 Prodat terminals that allow combination of 1.6 gHz satellite links and VHF radio to cover large oceanic areas where standard VHF communications do not reach. Tests are sponsored by SITA, international airline group with nearly 300 member airlines.

FCC has reaffirmed its original ruling to allow separate (from Intelsat) international satellite services, and clarified how such satellites can drop or provide services within USA as ancillary purpose.

SENATOR Albert Gore's satellite telecast to home dish and cable system viewers throughout Tennessee originated in Grand Old Opry and uplinked on Galaxy 1. Gore believes other Senators and Congressmen will conduct similar polithons increasing awareness of general population in satellite services and capabilities.

PRIVATE satellite system owners are concerned that NASA may actually prevail in getting commercial and foreign satellites removed from Shuttle manifests in future. Of special concern are those planning launch of next generation FSS and DBS type birds which are physically larger than current ELV launch vehicles may be able to comfortably handle. Western Union points out that launch of Westar 6 on Shuttle would have cost $19M while launch on ELV would run more than $30M; not an insignificant difference.

MARSHALL Space Flight Center in Huntsville, Alabama, has a new telephone number for those making inquiries concerning space related activities; 205/544-0034.

SPACE got turned down from EIA (Electronic Industries Association) after request that EIA help SPACE out with legislative and consumer awareness programs. EIA has formed own Home Satellite Subdivision of Consumer Electronics Group to study ways that giant electronic trade association can be helpful to struggling home TVRO industry. SPACE had hoped EIA would lend financial as well as manpower assistance to overall efforts to rescue home TVRO from clutches of cable. EIA has never been friendly towards cable, viewing cable interests as largely contrary to best interests of EIA members.

BRASIL is latest market for Equatorial Communications VSAT terminals. Agreement signed with Brazilian distributor provides for $30M in equipment to go to Brazil over next five years, to be used with specially leased transponder on Brazilsat.

SPACE has increased annual dues for dealer members to $300, a figure from the past since dealer memberships cost that much several years ago. SPACE's $95 figure was actually a money losing proposition since cost of publications supplied plus minimal services to each dealer typically run nearly $300 per year.

SPACE was scheduled to cosponsor, with Showtime, special scrambling party May 27th after scheduled May 26th full-time scrambling by Showtime and The Movie Channel. Object of party was to head off potentially negative publicity and news stories associated with full-time scrambling after HBO experience this past January 15th.

UNITED Video is adding additional equipment and management space at their suburban Chicago teleport as well as new pair of 9.2 meter uplink antennas for C-band.

HBO claimed it signed up 6,000 home dish users as subscribers in

first 90 days of offering service and that virtually all of the users signed up for both Cinemax and HBO. M/A-Com reported more than three times that number of descramblers had been shipped and CSD distributor survey found relatively small number of descramblers on distributor shelves. Mystery is where balance of units M/A-Com claims have been built have gone or how they are being used. Boresight's Shaun Kenny claims there is no mystery; large number of units are being authorized by people and firms who have discovered ways to hot-wire VC2000 units.

FCC has changed rules regarding licensing procedure for TVRO terminals. FCC dropped mandatory license requirement October 18, 1979, but offered voluntary licensing as method of protecting against TI (terrestrial interference) if receive-only sites required such protection. Under new simplified licensing system, terminals licensed receive even less protection and few guarantees against future interference.

US SENATE concerned that federal funding for ACTS satellite system next generation test satellite system that would operate as 20 gHz down and 30 gHz up should be reviewed. ACTS program was virtually killed in most recent budget planning. Senate worried that if US halts exploration of new generation satellite systems, lead in space communications technology might be lost to others. Japan has active 20/30 gHz satellite plan.

WESTERN Union, with back pressed to wall and financial tough times, has asked FCC for permission to create intra-Caribbean class of service. Concept is that unused transponder capacity on Westar 2, 3, 4, 5, and 6(S) birds would be useful to Caribbean. At one point, 6(S) bird was to have a spot beam for Caribbean for 6 or 12 transponders. WU has potential customer in Aruba for service.

WOLD Communications, carrier's carrier and large supplier of programming relay services to broadcast TV industry, is building extensive new Los Angeles (Hollywood) facility that will include 18 and 11 meter antennas for linking to Europe and Pacific via Intelsat or other international satellites. Systems will be for both C- and Ku-bands, will have ability to link Australia to Europe in two hops rather than presently required three.

ARIANE, European launch vehicle system, has justified approximately 20% increase in launch charges by citing continued devaluation of American dollar; denies raise in rates are tied to loss of Shuttle and fact that for now Ariane is only launch game in town. Launch rates for satellites in 3,000 pound range now being quoted are approximately $37M in US funds.

INMARSAT wants to get into mobile communications business, as a domestic service provider within USA, in addition to being international voice and video grade service provider in international areas. US firms interested in that business are concerned.

SUIT filed by Personal Preference Video in Texas charges that HBO, Paramount and others have conspired to limit home dish owner access to recent theatrical releases. Suit alleges boycott of home dish industry and programmers such as PPV. SPACE will probably join suit as will other viewer groups now forming.

INTERNATIONAL Herald Tribune now being edited in Paris and transmitted via satellite to 8 meter dish installed in Miami to feed 128 Kbps link to south Florida printing press. Editions printed there are being circulated through Caribbean, Central and South America.

HBO is an equal partner with Viacom (Showtime), 20th Century Fox, Columbia Pictures and EMI Screen Entertainment in new Japanese pay TV venture; the first for Japan.

RCA GLOBCOM has started service to Iceland using Intelsat's F3R bird over the Atlantic. Initially, it is limited to trio of telex circuits.

CALIFORNIA Amplifier has filed for protection under bankruptcy laws; firm was stellar performer in TVRO field 1983-84, made major contributions to LNA and LNB technology and was considered sensation in stock market because of meteoric growth. Cal Amp was suffering from Japanese inroads before current recession hit; sudden drop off in sales was final blow.

FUNDING originally curtailed for LANDSAT earth resources satellite may be found again under plan to combine LANDSAT and weather satellite functions into single, hybrid bird. Reagan administration wants LANDSAT to be transferred to private arena but so far no serious interest from qualified firms or groups capable of running service.

PICO Products reported loss of $327,000 (9 cents per share) for fiscal quarter ending January 31st. Firm blames satellite recession for losses, predicts sales will be slow to return to previous (pre-HBO scrambling) levels.

MEGASAT, UK based distributor of TVROs, is selling 40 1.8 meter dish systems for Ku-band to bookie shops throughout England. Shops will be part of a new satellite interconnected betting scheme. Sale represents largest single order for small dish systems in UK since government lifted restrictions on their ownership one year ago.

AT&T has announced SKYNET Service, new Ku-band point to point communications system using RCA Ku-2 satellite. Service offers two-way data, one-way data or one-way video for monthly equipment fees in $400 per month region.

ECS-5 is replacement for lost ECS-4 and will be launched early 1987. Eutelsat now inaugurating first digital telephone circuits for Europe using ECS-3 bird.

NBC completed switch-over from SBS to RCA Ku-1 bird with no hitches, moving 170 affiliates to 81 west. New RCA bird is from 3-5 dB hotter in most areas than SBS and NBC affiliates are pleased with the new service from 50 watt bird.

M/A-Com losses continue to be problem as firm lost nearly $50M in most recent quarter. Major business consulting firm has been retained to study possible mergers, division spin-offs and other possible restructuring.

SCIENTIFIC-ATLANTA also reports drop in earnings for third fiscal quarter and it attributes fall off to "a severe downturn in sales of home satellite terminals" caused by "the current confusion on the issue of scrambling."

COMPUTERLAND Store network plans to be largest privately owned and operated national satellite distributed television and data network in world when mature. Network kicked off April 1st and hopes to be feeding daily feeds to 650 stores with interim goal of 20 hours of programming per week. Service, on TR5 of Galaxy 2, includes video materials prepared for network by major suppliers of hard and software.

FLAT TVRO antenna is claim of Colorado firm now marketing antenna called Phasecom. Name may cause confusion since corporation of same name has manufactured cable TV headend products for more than decade. Colorado firm says antennas are approximately 5 feet by 5 feet, weigh just 20 pounds, will sell from $421 to $1,189, receive several different satellites at same time and have 42.5 dB of gain (reference not given).

CBS executives have responded that home dish owners have 'no more right to CBS satellite feeds than they have to listen in to a private long distance telephone call.'

USA TODAY now being transmitted to Europe from USA via satellite where printing plant in Luzerne, Switzerland, prints it. Eight months ago, Asian edition began being printed in Singapore after satellite link across Pacific.

BBC now thinks it will produce from 1 to 2 hours of news and features daily for satellite distribution to broadcast and cable outlets worldwide. New service might begin as test late summer for 30 minutes per day, expand over years time.

Coop/continued from page 4

PUBLISHER'S LETTER

FAIR IN THE AIR (... Finally)

We have received many letters of protest from cable subscribers who pay for their service and thus resent the fact that others simply point a satellite dish toward the heavens and receive cable programming for free. Now, at long last, the suppliers of cable programming have individually decided to scramble their signals to prevent non-paying viewers from enjoying their product. Starting with HBO and Cinemax, which began scrambling this past January, virtually all major suppliers of programming in the United States plan to scramble their signals by the end of the year.

As a cable subscriber, you will not notice any difference; your screen will retain its clear, high resolution image. But satellite dish owners will not be able to receive a discernible signal without buying or leasing a descrambling device from their local cable office or other sources. In addition, just as cable subscribers pay a monthly fee for programming, satellite dish owners will also have to pay for their programming on a regular basis. That's only fair.

We at Cabletime salute the cable program suppliers for taking this action against theft of signals. The program suppliers are entrepreneurs who have taken great risks and endured years of financial hardship to create and nurture their unique and exciting entertainment product. They rely on subscriber revenue to enable them to purchase rights to show top quality feature films and other programming, and to pay for production of original, exclusive programs. If individual or multiple dwelling dish owners were to continue receiving signals at no cost, it would unfairly keep the rest of us in the position of subsidizing those who take a free ride.

Your local cable company supports the efforts of the programmers and would be glad to answer any questions you may have on scrambling. You can also discuss other television-related subjects like VCR compatibility, video game hookups and home computers. It's smart to think of your cable office as a "one-stop home entertainment service center." They will be happy to help you navigate your way through the mine field of the new video technology so all your technology works together and gives you maximum benefit and value.

Happy viewing.

Peter Barton
Publisher

Opinions expressed by the publisher do not necessarily reflect the opinions of Cabletime or TCI.

Notice the use of hype; clear, high resolution image, for example. I have to wonder how many cable subscribers would actually rate their pictures as 'clear' and 'high resolution'?

How about the message that descramblers will be sold or leased by the local cable company office? Is that a statement of policy from TCI; that each of their system offices will stock, sell or lease, and service VC2000 descramblers?

The best slander is yet to come. Remember that the 1984 Act, signed into law by President Reagan, clearly stated that if a service such as HBO wished to collect money for its programming, it had two options:

1) Scramble, and offer the programming to consumers for a fee, or,

2) Create a national marketing program AFTER negotiation of fair rates.

If a service did neither of those two things, then the programming was available, free of charge, to anyone with a dish system. In other words, lacking scrambling and lacking a marketing system, there were no restrictions to your viewing those services. The TCI editorial, however, reads: "We at Cabletime salute the cable program suppliers for taking this action against theft of signals. (If) individual or multiple dwelling dish owners were to continue to receive signals at no cost, it would unfairly keep the rest of us in the position of subsidizing those who take a free ride...."

There is that word again; theft. The cable people seem totally unable to avoid use of some derivative of thief/theft when writing about home dish systems. They seem totally blind to the 1984 legislation that totally legitimized home TVRO use, with certain restrictions; that is not all that difficult to comprehend.

If this sort of editorial appeared in a publication from a small-time cable operator in Left Overshoe, it could be excused because the writer would probably not enjoy the luxury of a staff of advisors who checked every word he wrote. When you are dealing with a major MSO such as TCI, where every article such as this is read for content by both marketing and legal staffs before it goes to press, you cannot be so forgiving of the misstated contents.

There continues to be a deliberate program on the part of major cable MSOs to mold public opinion against us. We are thieves and scoundrels according to these people, and when a firm such as TCI mails its guides to nearly 3,000,000 homes, we have some sizeable number of US residents getting that message.

Back on the stage in Las Vegas as I talked with John Sie, I took him at his word when he said he wanted to drop the emotionalism and rhetoric and bring our two industries together at the bargaining table for meaningful discussions dealing with the real issues. I still believe that is possible but I also believe that Sie and others at TCI, if they are serious about bringing together an accord between TVRO and cable, should throttle back on their own emotional rhetoric in their own publications. Throwing stones is insane when both sides live in glass houses.

TCI's Fair is Fair editorial appeared in the March issue of Cabletime produced by TCI Cable.

The Character Generator

One of the more interesting software programs found in the VideoCipher system allows a programmer to spot illegal users of the home style decoders in commercial establishments. I first became aware of this some 13 months ago while discussing the VideoCipher with a representative of United Video (the WGN common carrier). We touched on this briefly in our June 15th issue of CSD, and after writing the June report, I had additional and second thoughts about the degree of warning necessary for those who might be reading this.

Every system such as VideoCipher has some built-in weaknesses. Some or perhaps most of those weaknesses require considerable time and expertise to discover; others are obvious to anyone with the power of reason.

For example, you own a motel and you have been using HBO in your motel for years with a private dish. Then along comes scrambling, and you have to go out and find a VideoCipher descrambler. When you sign up for HBO with your VC2000 descrambler, they warn you that you are authorized only to use the unit in your home; no commercial (i.e. motel) installations allowed. You smile and trot it down to the motel headend and plug it in. At that point, you are out perhaps $395 plus $12.95 a month for HBO but you are serving say 40 rooms in central Nebraska. Who is the wiser?

We all know by now that there are significant differences between the commercial style decoders (VC-2) and the home style units (VC-2000). One of those differences that is most evident is the on-screen graphics found in the VC2000. This is that series of text messages, many in permanent memory, which you can call-up on screen at will by pushing various buttons on Videocipher's control panel. You may recall that when you tune in, say HBO (east) on your satellite receiver there is a brief period when onto the screen pops a message which reads 'HBO EAST.' You think to yourself "Gosh, that is a nice subroutine; they are helping me be sure that I have the channel I wish by identifying the channel each time I change channels on my receiver." Uh-huuh.

That sub-routine is but one of several hidden inside of theVideocipher. The others may not hit you as being so cute.

Now, how does HBO really protect itself against you authorizing your VC2000 for your home and then hauling the unit to your motel? First of all, they can load into your VideoCipher text messages at will. You will remember that you can call up messages on the screen at will. You may even enjoy showing off those functions to friends without realizing what this sub-routine is really intended to do.

HBO wants to keep VC2000s out of motels, hotels, apartments and so on. So in the middle of the night (all devious things happen in the middle of the night) they load up every VC2000 in the country with a special text message. Then at 8:00 pm the next evening, just

as a block buster movie is starting, they command every VC2000 to display that text message on the screen; just like 'HBO EAST' comes up on the screen automatically each time you flip to TR23 on Galaxy 1. What does this devious text message say to the viewers?

"WIN $100 CASH RIGHT NOW! If you are staying in a motel, hotel, or living in an apartment, or condominium and you see this on your TV screen, call 1-800-XXX-YYYY to claim your cash prize!"

The cable decoders ignore this text; they have no such system. Home subscribers see it alright (as does everyone with a VC2000 decoder) but they don't qualify for the prize. A guy staying in your motel sees it and calls. Unwittingly, he just figured you as an illegal user of a home style decoder in your motel.

So we move to phase two. Having identified the motel user, the next step is to close him down. HBO figures they may have some difficulty hauling you into court just on the basis of a telephone call from a tenant. They also need to identify who you are and try to identify the actual decoder box you are using. If they can pinpoint the serial/operational number of your box, they can in turn shut it off at the uplink.

There are two ways to accomplish this, both built into the system.

1) While they have your tenant on the telephone, they can execute a software routine which places on the screen of all VC2000 decoded video signals, the actual serial number of the decoder. You may recall that your authorization number is available on the screen when you push certain buttons on the keyboard. They can push those buttons from the uplink.

"And will you please read us the numbers you see on the screen?" They ask the tenant on the telephone calling to collect his $100. "That will let us verify the accuracy of your location and properly qualify you as a winner in our contest." The guy reads off the numbers. Bingo. HBO just identified not only who you are but where you are supposed to be. In a few seconds time, if they wished, your HBO service could go bye-bye. Forever. Or, they could take their evidence and institute a lawsuit to hang you out to dry. Then they will cut you off.

2) Or, they can simply ask the local cable operator to stop by your motel, check into a room, and wait for instructions. He then becomes a private detective ready to verify on uplink command your unit and its illegal operation. Now they have more than a simple tool to cut you off; they also have an expert witness to take into court against you.

All of this is possible because the VC2000 has a software routine built into it which allows remote control of certain on screen displays. That's the strong point of the system. The weak point is that once alerted, people will begin disabling these software routine circuits and removing the on screen video display text circuits as rapidly as they can field a pair of IC pullers and a set of dykes.

I really expected HBO to have a 'gala contest weekend' to spot illegal users of the VideoCipher before now. I guess they have been too busy authorizing all of those tens of thousands of units in private homes to bother with their own built-in security system. It will be interesting to see how long it takes for people to figure out what you have to do to disable the on screen displays without destroying the balance of the inner workings of the VideoCipher.

I am not so sure it is illegal to do this, by the way. The law says you shall not steal scrambled programming and that you shall not misuse transmissions intended for private use (in homes) at commercial establishments. But the law does not

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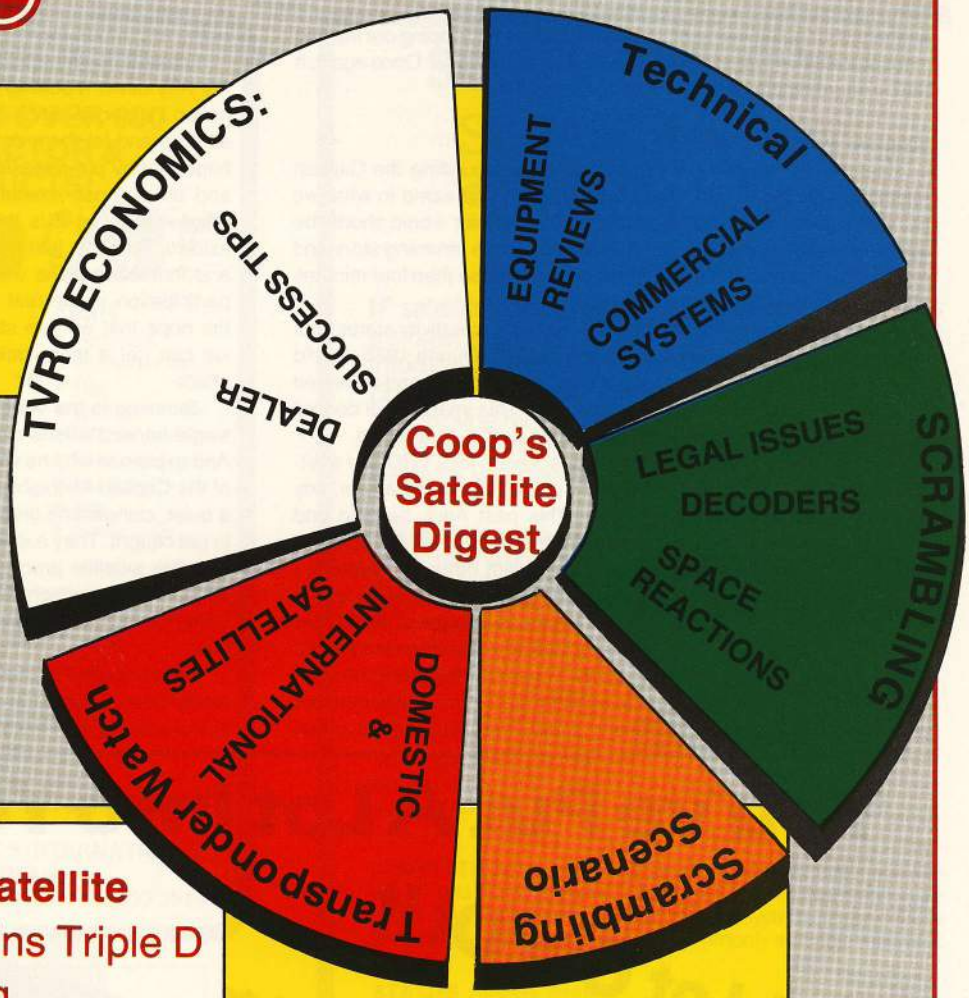

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address your going inside of your VideoCipher and ripping out the text message display circuits if you happen to want to do so. Once again, it will be interesting to see how it all sorts out.

Captain Midnight/Part Two

Last month, we reviewed the evidence surrounding the Captain Midnight jamming of HBO back on April 27th and came to what we felt was a reasoned conclusion that the perpetrator would shortly be apprehended. Let's look at another aspect of this jamming story and review now the probability that something far worse than four minutes of video jamming for HBO is ahead.

A fellow I know with considerable electronic creativity started out manufacturing TVRO pieces and parts in 1980. During 1985, he did $2.1 million in product sales (of his own manufacture) and pocketed $600,000 for his efforts, after all expenses. This year he will do well to pocket $25,000, and he is madder than hell at scrambling.

Another fellow I know was building receivers for TVRO. He averaged more than 1,000 per month through 1985 making a nice, tidy profit and having a very good time. This past April, he sold and shipped seven receivers. He is madder than hell at scrambling.

I could fill this page and the next page with other true reports. I won't; you get the idea. There are dozens and dozens of people in this industry who did very well when business was good. Right now they are not doing very well, and they miss the fun, the excitement, and the bucks of doing very well. Many of these people are frustrated. They had a fine, exhilarating taste of being successful entrepreneurs and the way they figure it, HBO and a few other 'spoil sports' came along and wiped them out.

I cannot condone what they are doing or about to do. In a sense, my very act of reporting on their activities is itself a form of condemnation I suppose, since if I was really on their side, I suspect I would shut up and let them do what they are setting out to do. I sincerely hope that by pre-releasing their plans, some small impact will occur and all of those executives in the offices of the spoil sports will reconsider what it is they have done to create the scenario that follows. Perhaps, just perhaps, they will reconsider their scrambling and marketing plans which to date have precluded TVRO industry participation in the real marketing of scrambled signals. I harbour the hope that we can still head off what I am about to describe, if we can get a more rational scrambled signal marketing plan into effect.

Jamming is the word. We wrote last month about the apparent single-handed efforts of someone calling himself Captain Midnight. And explained why he was likely to be caught. One of the side effects of the Captain Midnight incident was that it gave new enthusiasm to a quiet, clandestine group of TVRO entrepreneurs who don't expect to get caught. They expect to wreak havoc on the national distribution of cable satellite programming in retaliation for the demise of the TVRO industry which these entrepreneurs knew, loved, and helped build from an infant industry of the early 1980's. Here is what is being built.

As we studied in this commentary last month, if you are going to totally disrupt the signal of a service such as HBO, you must transmit to the satellite with a total power equal to or greater than the power

SCRAMBLE-FAX

SCRAMBLE-FAX
SCRAMBLE-FAX

by Bob Cooper

IF satellite scrambling is important to you, here is a single, authoritative source of timely, confidential information of great value; **SCRAMBLE-FAX**. Bob Cooper is routinely gathering all of the important scrambling facts and combining them into a single AIR-mailed 'Newsletter' designed to give you all of the facts you need in one, convenient, timely place.

SOURCES for pirate decoders, reports on export problems and equipment interfacing solutions. Advance warning on who is scrambling, when, and how (more than 37 channels have already scrambled; 20 with Oak Orion). All of the important, hard to locate information, in one publication.

COMPLETE, up-to-date listings on which receivers interface with the 'E' and 'E/B' version Videocipher descramblers; full table listing or who is scrambling, using which system. Technical tips for interfacing descramblers with commonly available receivers.

STATUS reports from DESug (DES Users Group) on progress made in 'busting' the videocipher coding; analysis of plans and books offered in field and value of each to users. Conversion of non-compatible equipment to Videocipher interconnection, and, much-more!

WESTAR Communications/Westcom, the Toronto area alleged manufacturer of 'pirate decoders' for HBO/Showtime and other Videocipher type scrambled services reportedly has been sold to a new group of investors; all Canadian. The firm has been offering their pirate-type decoder unit for $500 (US) for several weeks claiming it decodes all Videocipher scrambled video plus audio signals. Attempts to locate the firm other than through their 800 telephone number (1-800/265-5675) typically meet with failure and the firm is quick to explain that it would be inappropriate for them to identify their actual street address location (SCRAMBLE-FAX suggests you try 504 Iroquois Shore, Oakville, Ontario; and 416/842-2877 as their non-800 telco).

AND you are invited to call 305/771/0575 anytime for a free, 3 minute pre-recorded 'SCRAMBLE-FAX Hotline Update' report; the latest in fast-breaking scrambling news to augment your printed copy of SCRAMBLE-FAX. To order SCRAMBLE-FAX, call 305/771-0505 with your VISA/Mastercharge card number and expiration date. Or send $10 check or money order to the **CSD** address below.

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305/771-0505, or, free 'Hotline' service 305/771-0575. To order by mail, $10 in US funds to CSD Magazine, P.O. Box 100858, Ft. Lauderdale, Fl. 33310.

used by the programming uplinker. HBO uses 11 meter (36 foot) dishes and a nominal transmitting power in the 700 watt region. But, is it necessary to actually override the HBO signal, with a more powerful signal, to shut down the commercial viability of a system such as HBO? The answer is no.

Extensive tests reveal that if you carefully plan your jamming transmitter, you can cause noticeable interference with a total power of around 1/64th the power of the programmer. Total power, you may recall from our June 15th commentary, consists of the gain (size) of the uplink dish and the actual transmitting power of the uplink transmitter. Anything greater than 1/64th total power will degrade the object video.

Captain Midnight did his jamming with a professional uplink in the HBO class. To override or deliver a message stronger than HBO, it took that sort of power. But someone with far less power could cause the HBO programming to flip and flop on the screen, and tear and fall, if he created a jamming transmitter with only that object in mind. The techniques for this are well known, well documented, and well proven after more than 40 years of battling with the Russians, for example, for supremacy of the shortwave radio bands for worldwide radio broadcasting.

There are two practical problems when you don't have access, as Captain Midnight did, to an 11 meter class uplink and a 3,000 watt (class) uplink transmitter. How do you compensate for a smaller antenna and a smaller transmitter?

The transmitter first, since if you can resolve that problem, the antenna may take care of itself.

One of the reasons why there are perhaps no more than 50 of the 3,000 watt class uplink transmitters in use in North America is the cost of such an instrument. These are handmade units, very delicate to operate, and they cost as much as an average American house. To generate 3,000 watts of output power at 6,000 mHz requires some very exotic transmitting tube devices, and some very exotic powering and control circuits. They are not amateur circuits nor pieces of equipment; misuse, through careless operating procedures, is a good way to permanently ruin a $50,000 rack of equipment.

That's one of the primary reasons why you don't see people building uplink transmitters from parts purchased at Radio Shack. This is still a very exotic technology. But suppose somebody figured out a way to change all of that; suppose it was possible to create a transmitter which could generate sufficient power to jam HBO for say $700 or so? Then what might happen?

Enter something called pulsed emission. Here is what that is all about. The HBO uplink operates full-time, 24 hours per day. To crank out 700 watts or so full-time, and to have a control that can increase that power to say 3,000 watts on demand requires some very special parts. Everything in the system has to be "100% duty cycle rated." That means it is rated to operate all the time, at the rated power.

A radar transmitter is an example of a different design philosophy. It transmits a continuous stream of signals (like a continuous stream of dots in Morse code) but in between those dots there are significant spaces where the transmitter is turned off. These turn-off periods are important because when the transmitter is turned off, it is resting. During these rest periods, the active parts in the transmitter cool down and that allows them to operate more efficiently when they are turned on. So we have: DOT (turned off and resting), DOT (turned off and resting), DOT and so on. If the transmitter is turned on 1% of the time and it rests 99% of the time, it is said to have a "1% duty cycle." These on periods are called pulse periods in some circles.

A radar pulses for a combination of reasons. First, in between pulses, it is receiving signals; anything that bounces off of a target. Secondly, by taking a device that might be rated at 1 watt continuous duty cycle (i.e. 100% duty cycle) and only operating it 1% of the time, it might now be possible to have it operate at 100 watts peak power during the pulse periods. In other words, if you let it rest often enough, and long enough during the rest sequence, you can actually multiply the power of the pulse for a short pulse period by many times the 100% duty cycle rating.

One clever way around the $50,000 cost of a 3,000 watt power amplifier for generating 6,000 mHz uplink signals to the satellite is to not operate full-time; or, 100% duty cycle. Suppose that rather than taking a very special tube designed to create 3,000 watts 100% or the time, you took a much smaller tube (or transistor) designed to create 30 watts, 100% of the time. Now, rather than operating it 100% of the time, you operated in 1% of the time in a pulsed mode. You might find that you could now generate 3,000 watts of peak pulse power 1% of the time and then it would cool off (rest) the other 99% of the time.

That's what a pulsed emission is all about; taking a device intended for very low power and reducing its operating duty cycle to a small fraction of 100 percent. Remember, it is not necessary to be as-strong-as say the HBO uplink signal to cause damaging interference; it is only necessary that you be (as a minimum) 1/64th as strong. So you don't need 3,000 watts and an 11 meter dish. A far, far lower amount of power (say 47 watts) and an 11 meter dish would cause objectionable interference with a 3,000 watt uplink signal; if HBO was operating at 700 watts power (see my Comments for last month), the power required is even lower; 11 watts.

Not many people have an 11 meter dish, so what kind of power might be required with say a 3 meter dish? The math is not complicated; the answer is around 200 watts of power. That still seems like quite a bit until you remember the pulsed emission format. If you operate with a 1% duty cycle, the peak power can be 200 watts with a 2 watt device (amplifier). If you allow for transmission line losses and feed losses, you might want to use a 3 or 4 watt device pulsed 1% of the time to generate 300-400 watts of peak power. There are several things you can do to modulate the pulse to make sure it has maximum devastation power. The Russians are experts at that sort of thing and their literature is filled with practical examples. In short, the technology is not elusive.

Which brings us to the threat to the programmers.

We are now talking about commercially built transmitter packages which might sell in the $750 range. Products such as this, with a 6 gHz feed, bolted onto a 3 meter dish in Winnipeg or Cancun, could sit there for days nipping away at a cable programming feed. The concept I am hearing about would place several hundred of these gadgets in a loosely connected network around North America. To minimize detection and arrest, the users would merely dial through the scrambled program universe and spot a channel not being shot interference at that point in time. The gadget would be turned on and the channel wiped out until the clandestine uplinker tired of being a spoil-sport. Then, it would turn off and some other station in the interference network might take over.

All of this sounds extremely unpleasant. Certainly those of us still trying to seek out a living from a much deflated TVRO world would find it increasingly difficult to sell even a few TVROs a month if we have to explain scrambling, and jammers all in the same sales pitch. Of course, the cable programmers could probably only tolerate this sort of situation for a few days at most before they threw in the sponge; the first reaction would be indignation ('Criminal!') followed by the realization they were shut down and there was no one out there capable of hearing their protests. At least that is the counter argument I am hearing from those working on this project.

One way or the other, I predict that we will all be hearing quite a bit more about pulsed emission transmission systems in the next few months. Those who have been driven to this desperate move have watched their businesses collapse around them and their life styles deteriorate at a very rapid pace. I wouldn't call them fanatical but I certainly wouldn't call their planned actions rational either. And now, all parties involved are on notice.

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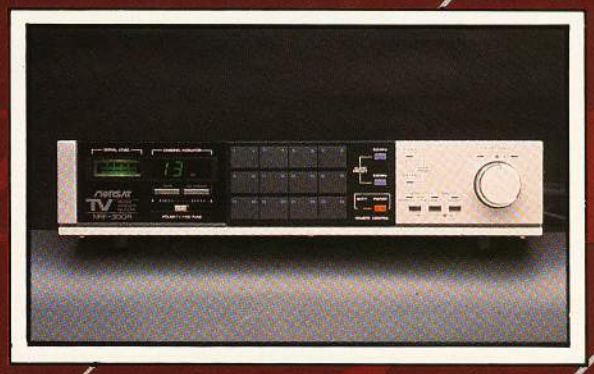

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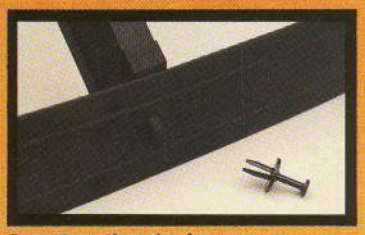

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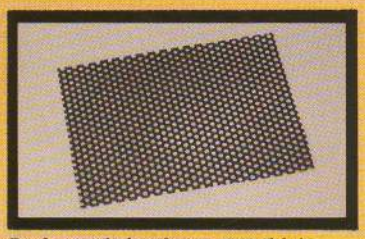

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