PLANE TALK cont'd

75,000 square miles and encompasses parts of five different states. *(See Table 1. Indianapolis ARTCC Sector Chart). We're very strategically located in that our main mission here - although we have some quite busy airports within this area, we certainly don't have any the scope of O'Hare - is that we handle the aircraft which are climbing or descending, and that makes for a complex situation.

We set up traffic for O'Hare and St. Louis (in and out); also for Memphis, Atlanta, the Washington, D.C. area, Pittsburgh, Cleveland, and Detroit. We get aircraft en-trail and departures and we'll take them up to their altitude(s), wherever they're going.

PT: How many sectors does the Indy ARTCC have and how many frequencies?

HH: Right now we have 26 sectors authorized to us, and we have approximately 23 remote communication air to ground sites which use microwave, telephone line or computer.

PT: How many miles does the normal radar range cover?

HH: The radar range coverage is line-of-sight, it would be about 150 miles. this goes up in terms of altitudes, by the way. Within this we'd have five radar sites and, brought back through the computer, it would give us our base (minimum) coverage here in our area at about 5,000 feet.

PT: Can you give us a thumbnail sketch of how modern radar works?

HH: Radar actually sends out a beam which travels until it hits something; then it bounces back. We have specialized electronics that interrogate the aircraft's transponder and the signal comes back.

A further development is the MODE C which gives us the aircraft's altitude. (Note: "Mode", in this sense, means the letter or number assigned to a specific pulse spacing of radio signals transmitted or received by ground interrogator or airborne transponder components of the Air Traffic Control System. MODE A is military and MODE C is altitude reporting.)

PT: What is the maximum altitude for a low altitude sector, and what are the minimum and maximum altitudes for high altitude sectors?

HH: The maximum altitude for a low altitude sector is 23,000 ft.; for high altitude sectors, it starts at 24,000 minimum and then the intermediate high goes up to 33,000. Then we have the ultra-high which goes from 35,000 ft. up (positive control) to 60,000 ft. For ATC altitude reporting, 23,000 feet is written as 23.0 and spoken as "two-three-zero"; the last zeros are dropped. Some military aircraft do not tell us their altitudes, but they fly above 60.0. We tell them if there's traffic up there, though.

NEXT MONTH: PART II--Frequencies and Radio Terminology

TV SCRAMBLING: Its History and Techniques

by John Wilson

HISTORY OF CABLE TV

Today's cable TV systems trace their origins back to the late 1940's to a small hilly terrain section of eastern Pennsylvania. The small valley town of Panther Creek was effectively isolated from decent TV reception from the larger metro area stations such as Philadelphia because of the surrounding hills and mountains.

An enterprising individual decided to install several antennas on one of the surrounding mountaintops and ran a long antenna cable line down to his TV. It worked pretty well, even with the tremendous signal losses in the long cable run.

Soon he was asked by one and then more neighbors to hook up to it. Not long after he realized the marketing potential; a company was formed and an industry was born. Following soon thereafter were politics and regulations.

The Fifties and Sixties

As the cable TV industry grew during this period it was still basically an antenna service primarily retransmitting local off-air VHF/UHF TV stations to subscribers who, for whatever reason, could not get noise- or ghost-free reception.

Occasionally, a distant TV station not normally seen in the cable TV's service area would be brought in by high antennas with pre-amps or was microwaved in and rebroadcast on the system.

Politics dominated by over-regulation were imposed upon the industry by lobbying broadcasters who viewed cable TV as an economic threat.

The Seventies

The seventies were uneventful until around 1975. A small New York area movie service being transmitted via MDS (multipoint distribution system) called Home Box Office (HBO), wished to microwave its signal to Philadelphia via the telephone company, but it was very expensive. RCA had launched SATCOM F1, the first domestic communications satellite. HBO figured that delivering their signal via satellite would not only be cost effective but would also open up untold new markets nationally via cable systems already in existence.

Ted Turner in Atlanta had recently acquired a UHF TV station, Channel 17; he envisioned providing WTGB via satellite to cable systems as "filler" programming, offering yet another station which would not normally be seen by the cable subscriber. Soon WTGB, now WTBS, was on the satellite as the first "superstation." The programming rush via satellite was on.

The cable systems carrying HBO as an extra pay service had a problem of how to protect their signal from unauthorized viewing (nonpayers). Scrambling of the signal at the cable TV headend was the answer.

CABLE TV FREQUENCY ASSIGNMENTS

The FCC has allocated the following TV channels for cable TV use:

a. 2-13: Regular VHF-TV channels and special equipment is not needed to receive them. Channels 2-6 (54-88 MHz) are referred to as "Low VHF" because channel 6 ends at the beginning of the commercial FM band (88-108 MHz). Channels 7-13 (174-216 MHz), "High VHF", begins just above the "High VHF Business Band (police, gov't, press, weather, railroad, etc. from 152-174 MHz).

b. A-I (Mid-Band): In effect a cable TV system is allowed to "carve out" 9 TV channels from 108-174 MHz; however, channels A through C cover the frequency range of 120-138 MHz which is assigned to the Aeronautical Service. RF leakage in this frequency range interfering with aircraft navigation and communication buys a cable TV company big trouble from the FCC as some cable TV systems have discovered; they get to pay fines for such occurrences. So the smart cable TV systems do not use channels A, B and C. However, these channels are used in certain sections of the country. Channels D through I are more commonly used for premium programming.

c. J-W (Super Band): A cable TV system in need of more TV channels may elect the Super-Band, 216-300 MHz, but the signal losses are very high at these UHF frequencies.

d. AA-QQ (Hyper-Band): Hyper-Band, 300-402 MHz, sees little use nationwide. It appears to exist for the cable TV systems which promised the world to the larger urban areas in order to obtain franchises and now have to deliver it.

TYPES OF SERVICE

A cable TV system is free to determine how it will provide its basic and premium (pay) services.

a. Basic: The most simple and common system is to provide unscrambled service on VHF-TV channels 2-13 at a basic monthly charge. No special equipment is required to receive these signals; however, one channel may be used to deliver a premium (pay) service in which case a piece of special equipment such as a Mid-band converter would be installed to receive the service.

b. Premium (Pay): The most common method employed in delivering a premium service it to transmit the signal on one of the Mid-Band TV channels D, E, F, G, H, or I. Reception security if afforded in that the subscriber's TV does not tune that frequency range (Occasionally a set with a flexible fine tune control can receive Mid-Band channel I near TV channel 6 with varying degrees of success. If the signal were scrambled on channel I then the video would be unviewable but the audio would be ok).

A Mid-Band converter is supplied to the pay subscriber which will allow the subscriber to view the basic service and the premium channel(s). For premiums signals scrambled at Mid-Band the converter will additionally have the appropriate descrambler circuitry built in.

SCRAMBLING SCHEMES

Currently five different encoding schemes have been approved by the FCC; three are quite popular. All generally use the same basic

TV SCRAMBLING cont'd

approach. Either the audio is removed from the VHF-TV channel being used and put on a separate subcarrier, or another audio subcarrier is added in the composite signal.

The video is scrambled by either removing, suppressing or masking the vertical and horizontal signal information which the TV must have in order to properly process the signal.

In order to produce a TV picture, the entire picture tube is scanned line by line for 525 lines per second from top left to right and downward; this is called a raster scan.

In reality only about 500 lines comprise the picture we view. Some lines contain signal technical control information and some lines are unused for the overscan area so the technical signal information would not normally be seen as part of the picture.

To observe these signals slowly adjust the vertical hold control on the TV until the picture begins a slight downward roll. This black area with a changing dot/bar pattern then can be seen.

Additionally, a blanking pulse is transmitted to "wipe out" the frame which has just been scanned completely so a new frame can begin. Television is a form of optical illusion and all this action happens so fast out brains register the video as a continuous action when, in reality, each picture frame is a unique entity--just as in motion picture film.

Gated Sync

This scheme is the most secure of the processes. The scrambler at the cable TV origination point (head-end) generates timed periodic pulses which suppress or weaken the vertical and horizontal synchronization pulses normally found on the TV signal which tells the TV when a "frame" has been completed.

To restore the video the sync pulse signals are inverted and transmitted on a separate RF frequency called a "pilot" frequency. Some commonly used pilot frequencies are 50.5, 93, 99, 108, 110.5, and 114 MHz. The pulses are detected by the descrambler and contain the video sync information.

To determine if this scheme is being used look at the scrambled video when it is "static," i.e., no moving scenes. The pulses should appear on the screen with the blanking pulses being light and the sync pulses dark, configured in a vertical bar display, and the video may have a "flippy floppy" look.

In-Band Gated Sync

Some cable TV systems used this scheme without transmitting the scrambling pulses on a separate RF pilot frequency; instead, the pulses are amplitude modulated on the audio carrier of the premium (pay) channel. This variation of gated sync requires the use of filtering and restoration circuitry to provide the necessary sync information to the TV. The scrambled video would look similar to the gated sync scrambled picture. A scope pattern of the signal would look similar to those shown in Fig.1.

Sine Wave Sync Suppression

This process is similar to gated sync suppression except a sinc wave is transmitted by the cable TV head-end to suppress the sync pulses. A scope pattern would be similar to those shown in Figure 2.

As with the In-Band Gated Sync method the scrambling sine wave is transmitted on the audio carrier of the premium (pay) channel. Descrambling the signal involves extracting the sine wave, inverting it

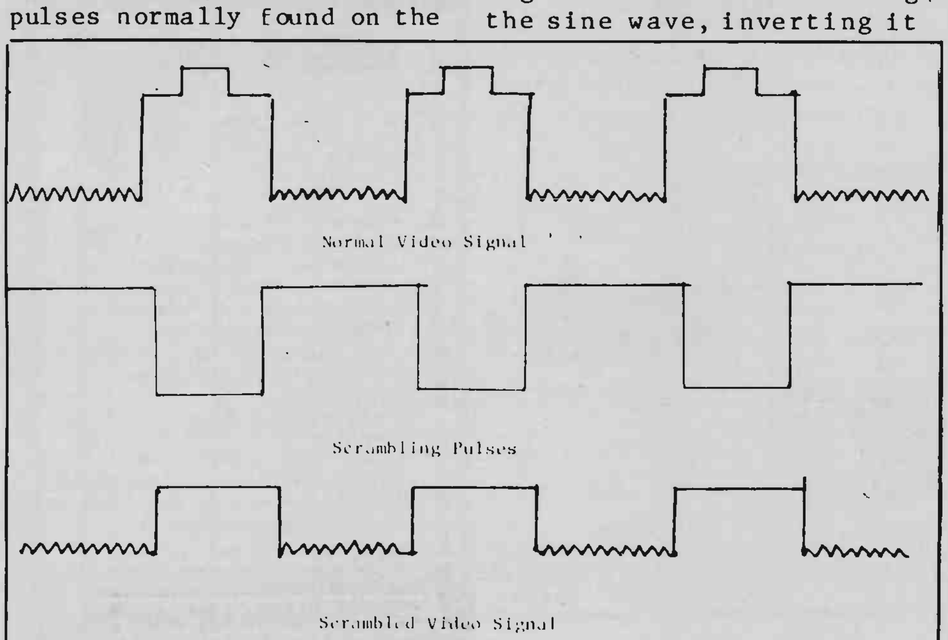

Figure 1

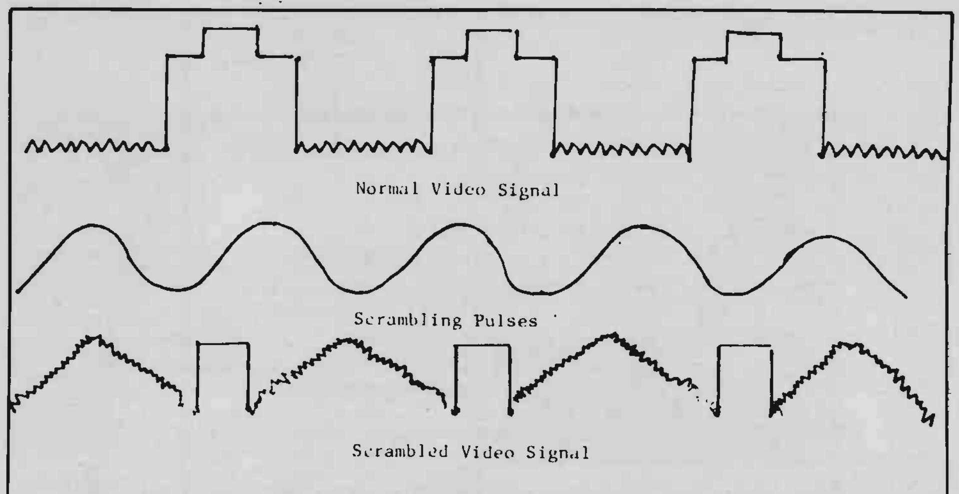

Figure 2

180 degrees out of phase and applying it as Automatic Gain Control (AGC) to the signal path.

The scrambled video appears similar to the gated sync except the blanking and sync pulses are closer to the center of the screen. The picture is brightest near the center of the screen and sometimes the vertical bar will drift right to left and begin again. No pilot frequency is used in this process.

Other Cable TV Schemes

a.Interference Signal Scrambling: In this method an FM signal is transmitted on top of the audio portion of the signal on the premium (pay) channel. Often a continual annoying whine or warbling sound accompanies the picture audio. Descrambling involves the installation of a high Q notch filter on the scrambling audio frequency.

b.Inverted Video: This outmoded method simply inverts the video and audio frequencies so that the audio, which is normally found at the high end of the channel, is now transmitted in what is normally the video portion of the signal and vice versa. Descrambling involves inverting the pair back for proper reception.

SATELLITE TV SCHEMES

Satellite TV signal scrambling must not be confused with cable TV system scrambling; Satellite TV scrambling schemes are related to manufacturer's processes whereas cable TV scrambling methods are popular industry process schemes with a number of manufacturers making the same type of scrambling equipment.

Oak Orion C

This very popular process is used full time on the ANIK D CanCom transmissions. It has had its problems, but appears to be a viable industry "player." The audio is digitized and then, using a National Bureau of Standards (NBS) algorithm, is placed in the baseband video at the location where the horizontal sync pulse normally would be.

Also embedded in the video is channel-specific encrypted digital information which is required to decode the particular channel. This information is carried in the first few lines of each field where the vertical sync pulse information would normally be.

General authorization control commands, which are (FSK) modulated, are transmitted globally on a carrier at 104.75 or 112.7 MHz. Both channel-specific and FSK information sent to the decoders includes "digital signatures" which authenticate that the information has been transmitted to the appropriate decoder.

Oak claims to have up to 49 tier levels of such programmable security incorporated, but it is doubtful that Oak Orion C programmers go above tier 1.

Multiple Application Adressable Secure Television (MAAST)

MAAST employs two modes of video and audio scrambling. The highest security is achieved by operating the video in the sync removal mode. Here all vertical and horizontal sync is removed and the blanking level is moved to the grey level. The video is inverted.

The audio is quadrature modulated with suppressed carrier and randomly time-multiplexed between audio channels in a form of frequency hopping. Lower security is attained by inverting the video and sync and offsetting the program audio.

MAAST claims to be able to transmit up to five channels of audio for each TV channel, but typically only one is transmitted.

The MAAST system, as with all satellite TV schemes, is unforgiving of out-of-tolerance equipment. If the transmitter scrambling frequency and audio frequency are not "dead-on," *TV SCRAMBLING cont'd*

then inundating wavy lines may appear on the video and, if the audio transmitter is off-tuned, then the audio will be mushy to unintelligible. The same holds true if the decoder is off frequency or performing out of tolerance.

Presently on the Fantasy Channel, (now called the Fantasy Unrestricted Network [FUN] Channel), uses the MAAST system for regular programming. The FUN Channel uses Oak Orion C for pay per view event programming.

RCA's 1 for 1

Still an experimental prototype system which basically involves interleaving lines of video from one and the other to form a double image system. The cost of decoding is quite high since the video must be put back together at baseband on the receive end by simulating alternate missing lines in each picture through an above and below comparison.

MACOM LinkaBit (Videocipher II)

Like the Oak system the video is basically sync-suppressed inverted with some additional unique suppression applications with the audio being digital. All addressing and control functions are contained in a high speed control channel which is protected by a sophisticated NBS Data Encryption Standard (DES) algorithm. This digital control channel is also transmitted during the horizontal sync interval, along with two digital audio channels.

MACOM claims the Linkabit process will support up to 64,000 different tiers. HBO, Showtime, and the Movie Channel have chosen the Linkabit scheme.

Inverted Video

Process the same as discussed earlier and was a very popular method used from 1978 through 1983. This method is rarely used for satellite TV transmissions today as most satellite TV receivers have built in video invert switch capability and the picture is easily restored.

CABLE TV SYSTEM THEFT OF SERVICE

Cable TV systems discovered from the beginning that if a means exists to encode then a means exists to decode. Presently there are approximately 30 million cable TV subscribers in the country. The trade industry estimates as many as 10 million subscribers are receiving premium services illegally. Since decoders are basically passive in nature one almost has to have been seen in operation to know it exists.

In desperation some cable systems have offered a reward system for information. To say the least, an interesting conversation should result after a child has turned in his parents to the cable company for having an illegal decoder and the parents have to cash the reward check for the child because he or she is a minor!

Federal legislation passed in 1984 as part of the Satellite TV Viewing Rights Act now makes it a federal crime to sell or use any decoder for unauthorized reception of a transmission regardless of the media used whether it be cable TV, satellite, fiber optics, MDS, etc. With the enactment of the legislation most of the previous private sector sources of such clandestine equipment went out of business. However, there still is a tremendous volume of such equipment out and in use and such items will probably show up at hamfests and flea markets for many years to come. ●

BEHIND THE DIALS

The BC-800XLT... an owner's report

by Bob Parnass, AJ9S

Manufactured in Taiwan, the 800XLT is the first programmable Uniden/Bearcat scanner to cover a portion of the 800 MHz band. Covering 40 channels in 2 banks the 800XLT is specified to receive in the following ranges:

TABLE 1. 800XLT Frequency Coverage

29	-	54	fm
118	-	135.975	am
136	-	174	fm
406	-	512	fm
806	-	912	fm

Note that only a portion of the new 902-928 MHz ham band is covered.

A FEW COMPARISONS

There are several differences between this scanner and its Bearcat predecessors:

--There is only a single scan/search speed: fast!

--800XLT channel banks contain 20 channels, not 10 as in previous models. Doubling the number of channels in a bank is a step backwards.

--Scan delay, channel lockout and priority are indicated by separate colored LEDs rather than the numeric display, making a colorful light show.

--Both the selectable scan delay and the priority sampling period are 3 seconds vs. 2 seconds in the older scanners. I like the 3 second scan delay, but would opt for a 1 or 2 second priority sampling period.

--Despite claims on the 800XLT box to the contrary, a 2 digit channel counter is displayed which scanning, as in the BC350, rather than "rolling zeroes" of the BC 210/220/250/300. This is unfortunate, as rolling zeroes make it easier to discern what channels are locked out from scanning without having to step through each one manually.

--The keyboard has a good feel, although quite different from the "chicklet" keyboards on Bearcat 250 and 300 scanners. Keys travel further with less of a positive click. The 800XLT keyboard is much easier to read, as each key has its function printed right on the keytop rather than labeled above it on an inlay.

--The 800XLT seems to lack "window detection" circuitry, so the scanner may stop prematurely (off frequency) in the SEARCH mode.

--There is no date of manufacture stamped on the cabinet.

--Mobile DC power cord is optional, but is supplied as standard equipment with other Bearcat scanners.

INSIDE APPEARANCE PLEASING

The inside of the 800XLT consists of three circuit boards:

1. a main receiver board containing VHF/UHF front ends, IF stages and audio amplifier;
2. a feature board containing microprocessor and keyboard logic; and
3. an 800 MHz front end board which uses surface mount components.

The boards appear very neat and it is obvious that computer aided design and automated component insertion techniques were used. What a welcome change from the chaos inside a hand assembled BC250!

No schematic diagram is furnished. Whereas the identity of many of the ICs in earlier Bearcat scanners was obscured by the use of "house numbers," the ICs in my 800XLT are clearly marked with their original designations (e.g., "National LM382"). This makes repair easier, as one may obtain parts from several sources rather than being forced to buy from Uniden.

SIDE-BY-SIDE COMPARISON

Side-by-side tests were performed, switching a ☞