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Radio World
ENGINEERING EXTRA
December 12, 2007

WHITE PAPER

What Are We Doing to Ourselves, Exactly?

IBOC FM Interference Has Been Reported in Several Cases Where FCC Contours Provide Inadequate Protection

by Doug Vernier

With the formal approval of FM IBOC by the FCC, the entire industry needs to take a closer look at what we are doing to ourselves. In this article, we will look at what we know about the impact on analog coverage caused by HD interference.

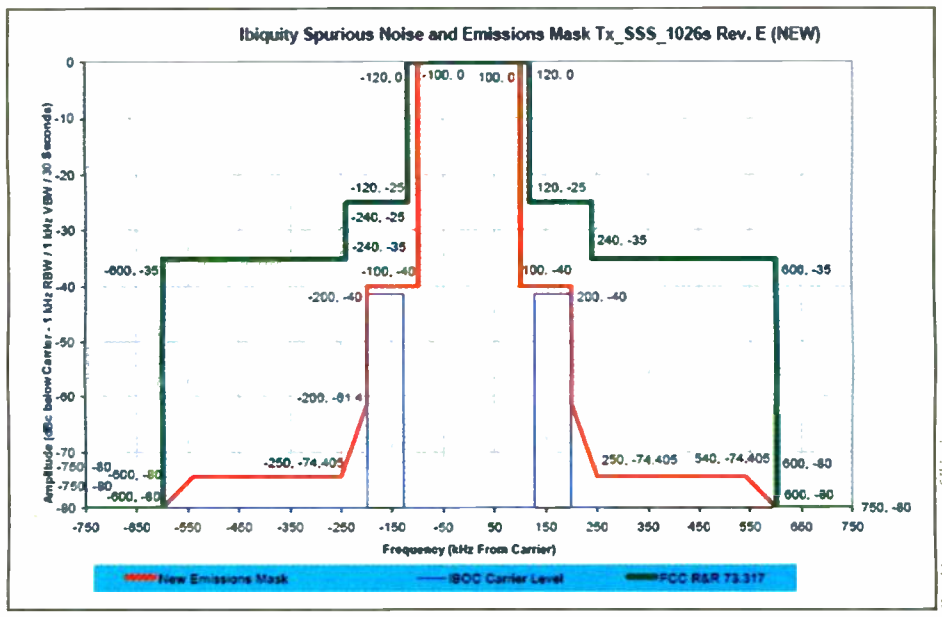
At this writing, in the last eight months the number of stations transmitting IBOC increased by 333 to a total of 1,516, based on Ibiquity's figures. In April 2006 there were 200 HD2 multicast stations on the air, and that has now grown to well over 700. Most of the IBOC inroads have occurred in the nation's larger cities.

With this kind of growth the potential for interference also grows. While IBOC is a gift of new spectrum from the FCC to your station, it may not be a gift to your neighbors. The IBOC methodology places the Orthogonal Frequency-Division Multiplex carriers on both first-adjacent channels, a possible sore point within an allocation system that never intended it (see Fig. 1).

FIRST-ADJACENT FM INTERFERENCE

The NRSC DAB subcommittee report, "Evaluation of the Ibiquity Digital Corp. IBOC System," concludes that because the first-adjacent HD digital side-band of a station occupies the same spectrum as another first-adjacent station, "first-adjacent channel compatibility is one of the most significant challenges for the FM-IBOC system."

Fig. 2 from the NRSC report shows that the energy within the desired channel is overlapped by energy from the first-adjacent hybrid station. The undesired station's lower digital carrier is actually inside the desired station's main analog channel. If two stations operating with analog and IBOC are first-adjacent, they will be transmitting on each other's frequency.



Graphic courtesy of Ibiquity

The New Ibiquity Emissions Mask. Author Doug Vernier explores IBOC FM interference problems in the accompanying article.

For situations where there was only one first-adjacent signal, IBOC performed as good as or better than analog. However, NRSC observed that many radios experienced a significant decrease in the signal-to-noise ratio of the analog station when IBOC was added to a first-adjacent station.

The NRSC introduced subjective testing to determine the degree to which HD first-adjacent interference was intrusive. To do this they developed a series of listening tests where Mean Opinion Scores (MOS) were generated by subjects who were listening to speech programming with moderate interference (Fig. 3).

These listeners were exposed to analog audio, without first-adjacent HD interference and then with it. The mean opinion audio quality scores are seen on the vertical axis. The white bars represent the analog audio quality with IBOC on.

This shows that listeners subjectively observe a significant deterioration of the quality of a station's analog signal in the presence of first-adjacent hybrid interference at moderate and severe levels.

For listening outside the protected contour, 21 out of 58 tests suggested there would be new interference. These tests were on automobile radios, which are known to have more immunity to first-adjacent interference than portables or table-tops, which were not tested.

IBOC is a gift of new spectrum from the FCC. Although this gift may be good for your station, it may not be so great for your neighbors.

DUAL FIRST-ADJACENT INTERFERENCE

An even more serious problem occurs when first-adjacent stations are on both sides of a station running IBOC.

NRSC tests of dual (both upper and

SEE CONTOURS, PAGE 8

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Next Issue
Radio World: December 19, 2007
Engineering Extra: February 20, 2008

Radio World (ISSN: 0274-8541) is published bi-weekly with additional issues in February, April, June, August, October and December by NewBay Media LLC, 5827 Columbia Pike, Third Floor, Falls Church, VA 22041. Phone: (703) 998-7600, Fax: (703) 998-2966. Periodicals postage rates are paid at Falls Church, VA 22046 and additional mailing offices. POSTMASTER: Send address changes to Radio World, P.O. Box 282, Lowell, MA 01853. REPRINTS: For reprints call or write Caroline Freeland, P.O. Box 1214, Falls Church, VA 22041; (703) 998-7600; Fax: (703) 671-7409.

FROM THE TECH EDITOR

by Michael LeClair

First Filing Window Opens and Closes

The FCC Gets a Pretty Good Grade for Awareness Of the Serious Nature of This Window

If you work for a non-commercial group or station, the odds are high that you found yourself pretty busy recently.

The first-ever window to file for new non-commercial stations opened this fall and it certainly consumed a great deal of my time in preparation.

A filing window is a relatively short time period during which any interested entities can file with the FCC for a new station license in the non-commercial educational band. The concept of using a window in the non-commercial band was developed to replace an older system with procedural flaws that could not keep up with the demand for new FM licenses.

The commission said about 3,600 NCE applications were filed, and I expect those were sent by a wide range of parties hoping to gain some new spectrum. It is hard to say how long it will take the FCC to process this large a group of applications.

In my initial scan of what has been filed in our area, for every location in which an allocation study showed an opportunity to file for a license, approximately eight parties filed competing applications.

Those applications that appear to be mutually exclusive have been posted as "Tendered for Filing" in the FCC database. That would suggest that selecting the winners will consume much of the commission's time for the next year or so.

The high volume of applications also demonstrates that many considered this filing window to be the last opportunity to obtain a non-commercial FM license — after this one the entire spectrum may well be full wherever there are people.

As such it represents an important milestone for the FM technology developed by Major Armstrong, which has moved to dominate the radio business in the last 30 to 40 years after languishing for the first 20 years of its existence.

Even FM radio stations that by definition are non-profit have now become hugely desirable, and all available spectrum may soon be in use. Does the filling up of the FM band create an argument to take over some additional spectrum in the soon-to-be less crowded television VHF band?

A GOOD EFFORT

I would have to give the FCC a pretty good grade this time through; its actions showed an awareness of the serious nature of this filing window and sensitivity to existing broadcaster concerns. The procedures for filing were set up in such a way that only a fairly serious applicant would go through the process to complete everything properly.

Deficient applications risk dismissal by the FCC without chance for reconsideration. This discourages casual applications and attempts to "greenmail" prospective broadcasters by filing nuisance proposals that are never meant to be built.

Technically, the window went about as well as could be expected given the number of filers and the amount of material to be handled. While there was the predictable server crash toward the end of the window, the FCC immediately extended the filing time for a few days over the weekend to give everyone affected an extra opportunity.

Within four weeks, basic technical information on the new applications was made available on the FCC database so applicants could see the results of the filing window, including any unopposed applications that seem likely to get a construction permit grant in the near future.

Even FM stations that by definition are non-profit have become desirable, and all available spectrum may soon be in use.

That's no small feat when you consider the amount of information that quickly had to be reviewed and analyzed for conflicts.

The FCC decided, almost at the last minute, to limit the number of applications from each filing entity in an effort to reduce the number of mutually exclusive proposals, with the hope that this would allow a faster and more efficient resolution. Some groups have shown themselves capable of generating literally thousands of applications, as seen during the translator window that was opened a few years back.

This limit seems to have curbed the more excessive attempts. But the fact that there had not been an opportunity to file for a new NCE license in more than seven years ensured that there would be a large volume of applications nonetheless.

Additionally, the FCC has created a new evaluation category for NCE applications that rewards proposals to bring service to unserved or underserved areas. The diversity of service criteria helps to bring FM services to areas that are not concentrated in heavily populated urban areas that already have a large number of non-commercial outlets. This is a worthy goal in my opinion.

However, with all the mutually exclusive applications, it still looks as if this filing window with so much at stake will require a few years to finalize the award of many new construction permits.

This is made worse by the fact that it appears some applications that stand no chance to be built due to technical violations of the rules were still successfully filed and will block others with legitimate proposals for some time until the details are worked out.

I don't see how this could be entirely avoided, but it seems to put the onus on the individual applicant, rather than the FCC, to "prove" that its competitors should be dismissed on technical grounds. This could become a substantial burden to the individual applicant. A rapid evaluation of the technical validity of all competing applications would permit faster resolution of the large number of mutually exclusive applications.

It also would be helpful if individual applicants could easily determine exactly which applications are competing in a specific case. Knowing the interfering conditions for a particular application is the first step in evaluating a project's chance for success and if negotiation will be possible with other applicants.

Overall this was a good effort from the FCC. While this process may take some years to unwind, the interest in new stations is at such a height that a fair amount of time seems justified in order to provide fair consideration to everyone.

DON'T TRY THIS AT HOME

We have another great story of engineer sleuthing in this issue, this time submitted by Tim Nelson of Cumulus in Wilmington, N.C.

Tim sprang into action when his digital STL began to experience what appeared to be random audio dropouts one afternoon.

I am continually amazed at the resourcefulness of individual engineers in tracking down radio frequency interference problems and Tim's determined efforts paid off in finding the offending party. But I would caution anyone who finds themselves in a similar situation that confronting someone causing interference could be dangerous, and perhaps the best method to handle such a situation is to contact the appropriate authorities with your information and let them handle it.

If you have encountered an interference situation or other station mystery, how did you solve it? Drop us a line and maybe we can use your story as well. Our e-mail address is *rwee@imaspub.com*. ■

IN THIS ISSUE

by Charles Dubé

Translators Bring Classical Music to the Berkshires

WFCR Shares 'Journey' of Retransmitting A Signal; Site Selection, Careful Plans Critical to Project's Success

With its 600 watt TPO Broadcast Electronics transmitter, this cabinet required upgraded ventilation.

In 2003 we learned the FCC was planning to open up a window for FM translator applications for the first time in quite a few years.

WFCR(FM) had been waiting for the opportunity to enhance coverage in areas where the terrain isn't sympathetic to our main signal. Within a few months, several sites had been scoped out for their usefulness and ability to relay the host signal. Discussion began with various tower and site managers about the feasibility of renting space.

History was on our side as we stood to benefit from the massive cell tower build-out of the recent decade. In many areas, towers now existed where none had before, and the options available were greatly enhanced. We were no longer limited to building our own towers (an expensive proposition) or locating on rooftops, church steeples or the relatively small amount of business communications towers.

Retransmitting a signal seems a pretty straightforward task. However, the realities of dealing with local town governments and tower owners can provide for some unexpected surprises, as do the physical realities of trying to make a translator work in areas where, well, conditions might not be ultimate. The 36 months you are given by the commission during the construction-permit period can indeed be eaten up voraciously by these events.

This article attempts to recount some of our journey.

IT'S ALL IN THE DELIVERY

The FCC defines the translator as a service to retransmit an FM broadcast station into areas where the station's direct reception is impeded by terrain barriers.

This can be accomplished by a direct retransmission of the station's primary signal or another existing translator's signal if it can be demonstrated that the region still contains some essence of the primary signal. In other words, translators may not be used to daisy-chain the station's signal beyond specified geographical limitations.

Another misuse would be to utilize a translator as an STL. CFR Part 74 contains the details on prohibitions and allowances regarding purpose and program delivery.

Additionally, there are some differences between non-commercial education stations and commercial stations.

For instance, an NCE is prohibited from using any program delivery method other than off-the-air reception if its translator frequency is outside of the NCE portion of the band. Commercial stations (and NCEs locating in the educational portion of the band) may utilize a variety of program delivery methods including satellite and DSL modems.

LOCATION, LOCATION, LOCATION

Once we narrowed down the potential target communities, it was time to locate the transmitter sites.

The base criteria was whether the primary signal can be received in the location where the translator's receiver is to be, and whether the re-transmission spot would effectively cover the area. Seeing that the frequencies available to us were all located on non-reserved channels, we were restricted to the use of direct path reception of the host station. This can create challenges.

On two occasions we were forced to change our translator reception to another nearby translator just to overcome fading due to seasonal changes, despite the fact that reception of the host signal was quite robust at times. This minor change is allowed and must be reflected in either a modified CP or license.

In the early days of my research I set out to determine whether or not the primary signal would be adequate at the proposed sites. I did this with a receiver and a directional antenna. Although on the days I visited, the host signal was sufficient in some locations, I later found this to change, sometimes dramatically. Reflections and refraction can hinder as well as help on any given day, and their temperaments are mercurial.

In hindsight, the use of a consultant who could have provided a signal path study would have been a wise investment. A Longley-Rice study of the host signal might have been helpful as well. Repeated visits to the location with a receiver capable of measuring signal strength and multipath will greatly enhance the chances of success.

Some tower companies are more responsive than others when it comes to contracts, especially if they manage thousands of sites. It may take months before a contract is sufficiently negotiated.

Proofreading the contracts also is key. Some companies representatives might not be as familiar with radio broadcasting as they are with cellular or two-way radio services, and therefore items that are pertinent to your construction permit should be well reviewed before signing.

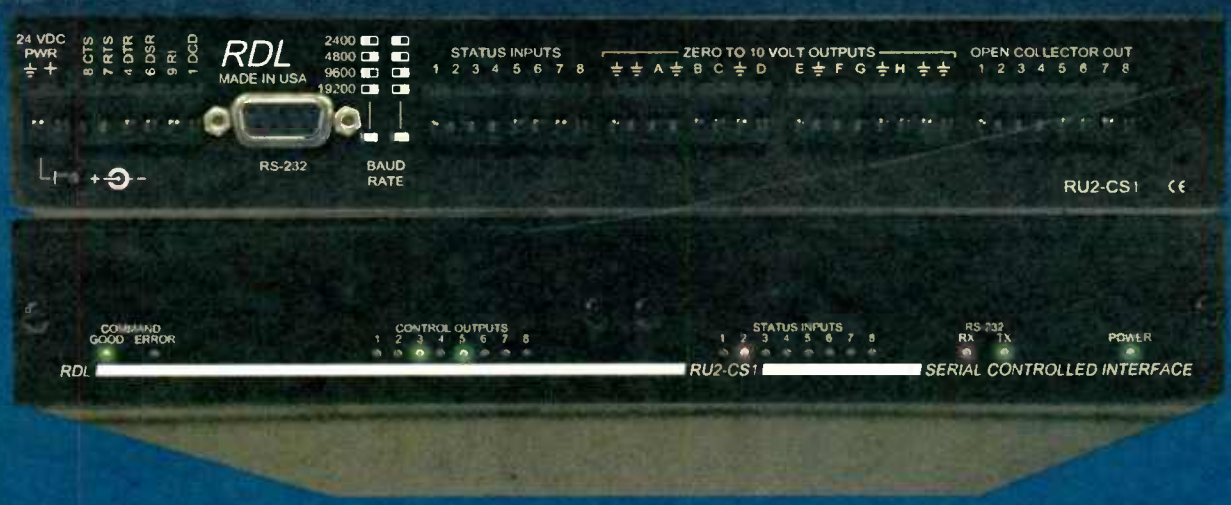
THE CPs ARE HERE! NOW WHAT?

Once we had contacted the management of a particular site and agreed that it would work technically, the next step was to determine what frequencies and power levels would be available for us.

Roy Stype at Warmus and Associates was called upon to run pattern studies on the locations and see what the potential was. How much power can we run without

SEE TRANSLATORS, PAGE 24

GET EVERYTHING UNDER CONTROL



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- RS-232 Control of Many OEM Products
- Eight 0 to 10V (or 0 to 5V) Outputs
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  Examples include sensing contact closures from satellite receivers or from RDL audio or video detection modules.
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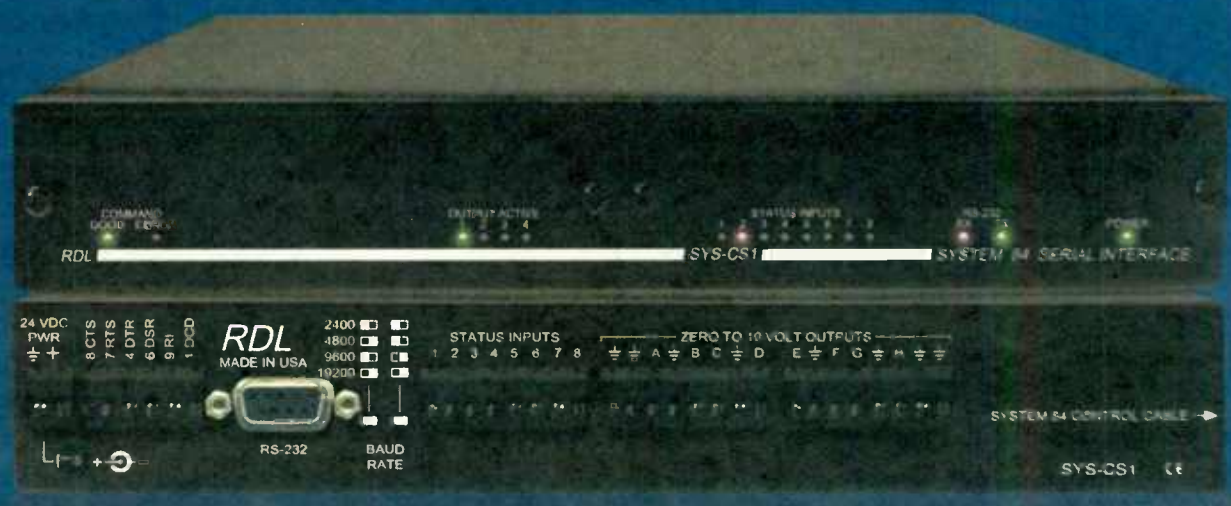
- Status Inputs from Eight Sources
  Examples include sensing contact closures from satellite receivers or from RDL audio or video detection modules.
- Rack mountable using RDL RU-RA3HD



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by Tim Nelson

I Cracked the Case of the Phantom Signal

STL Interference as a Result of an Illegal Source Sends Cumulus Engineer on a Wild Chase

For a broadcast engineer there are few things more frustrating than an intermittent problem.

Sometimes they clear up by themselves before you ever find the source. But it's far more satisfying when you manage to solve the mystery.

On my way home from the studios at about 4:55 p.m. on a Wednesday, I got a call from an announcer that his station had just dropped off the air even though the needles on the board were still moving.

I switched over in time to hear it come back on. As the station came back, it sounded like digital dropout for a second or two and then it was fine.

I immediately figured it was probably in the Starlink STL system, so I took the long way home via the transmitter site. Everything looked good; plenty of signal strength. Moseley had just had me swap out both the transmitter and receiver modems because the serial numbers of mine fell into a recall, so I was a little suspicious. I reset the error counter and headed for home.

I got the same call the next day at 4:55 p.m. I went back to the transmitter site and found the receiver had recorded several more errors. I began to think this was outside interference.

To prove it, I gave my friend Roger Brace a call. He's a contract engineer who covers for me and happens to have a spectrum analyzer. He agreed to meet me out there the next afternoon.

I also talked to the tower owner to see if there were any new tenants or equipment that might explain it. The only thing the owner could think of was that someone had started accessing wireless Internet from that tower. They traced the credit card back to a Russian ship that docked at the nearby state port at about the same time I started having problems.

On Friday we put in a tee in front of the Moseley filter, hooked up the spectrum analyzer, set it at my 949.0 MHz and

Fig. 1: Spectrum analyzer display under normal conditions. Note my STL signal is the small one in the center at 949.0 MHz. The divisions are set to 10 MHz.

Fig. 2: This is the interfering signal. The scale is the same as the previous photo.

waited; 4:55 p.m. came and went. Then at 5:03 p.m. the station dropped out again.

On the spectrum analyzer, a huge signal that almost totally covered my STL signal and its width filled the screen. After a few seconds it was gone and the station came back. (See Figs. 1 and 2)

Neither of us had a clue what had just happened.

I figured the next thing was to try to get a bearing on it. I had a four-foot dish. Fortunately Roger had a small 950 MHz Yagi.

Nothing happened over the weekend, so I started thinking it was a weekday end-of-business-day data dump of some type.

On Monday we set up near the ships at the port, wondering what kind of secure spread-spectrum espionage uplink equipment might be on board the Russian ship. At about 4:40 p.m., the station dropped out for just a few seconds but we did not see the signal. We moved back to a parking lot closer to the tower to see if it would happen again.

It didn't, but a couple of guys approached us wondering what we were doing with an antenna on an 8 foot x 2 inch x 2 inch pole, as they deal in hazardous materials. We said we were radio broadcast engineers on a mission and they said, "Okay then."

The next day we set up at a different location close to the tower. We were ready by 4:30 p.m. to make sure we would catch the interference and at 4:48 p.m. it appeared. It was a block that stood up –50 dB from 910 MHz to 970 MHz. We saw it slowly rise up until the station dropped out.

By swinging the Yagi I could tell it was not coming from the tower or the direction of the studios. I got a good bearing on it before it dropped off and the station came back. After it was gone I swung the Yagi around and saw what looked like an answering signal at 150 degrees from the first signal. The mystery deepened.

I posted on our Cumulus Engineering site and *radio-tech@broadcast.net* to see if

SEE HASHBUSTERS, PAGE 22

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Broadcasting a live Phoenix radio program from out to sea would be challenging for even the most seasoned veterans. Not for Attorney and Certified Financial Planner® (and world traveler) Keith DeGreen. Keith is shown here using the Comrex ACCESS Portable as he and his ship, The Global Adventure, approach Koror Harbor In The Republic of Palau—450 miles east of the Philippines and 7,200 miles from Phoenix!

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Contours

CONTINUED FROM PAGE 1

lower) first-adjacent interferers show that significant interference to HD reception starts occurring at a point when one of the two undesired stations is 21 dB below the desired station, and when the other first-adjacent station is within 6 dB below the desired station.

Under our current allocation scheme, Section 73.509 of the commission's rules requires that first-adjacent FM stations must be only 6 dB below the desired station's protected contour. While there are not currently a large number of dual first-adjacent situations, when dual first-adjacent stations are present it doesn't take much signal from them to cause the HD to fall apart and for the receiver to blend to analog.

GRUNGE IN THE FIRST-ADJACENT CHANNEL

A recent change in the Ibiquity emissions mask, designed to make it easier for HD transmitter manufacturers and stations to meet the mask requirements, doesn't help this situation.

Fig. 4 (see graphic on cover) shows the new spectral mask in red and the FCC's standard analog mask in green. The area of change is in the region between 200 and 250 kHz from the center frequency both above and below the analog FM channel.

This change created a gentler slope that may allow more stations to meet the mask when converting to digital; however, the change also allowed more digital energy to be transmitted in the first-adjacent channel, which under some conditions may be troublesome.

The spectrum analyzer capture shown in Fig. 5 is of a real station's first-generation IBOC equipment in test operation.

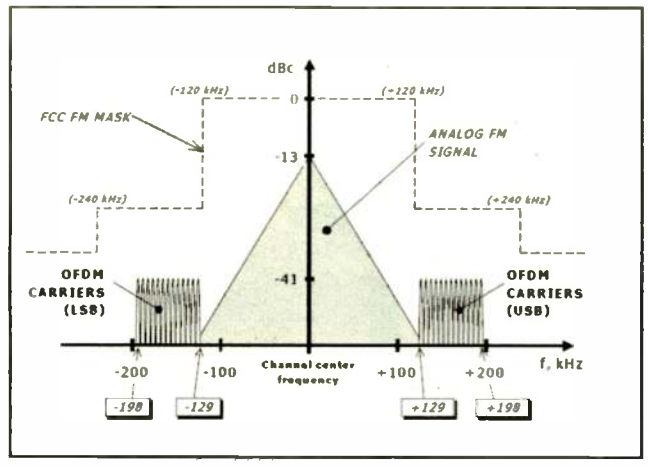


Fig. 1: Ibiquity FM IBOC Spectrum Power Density

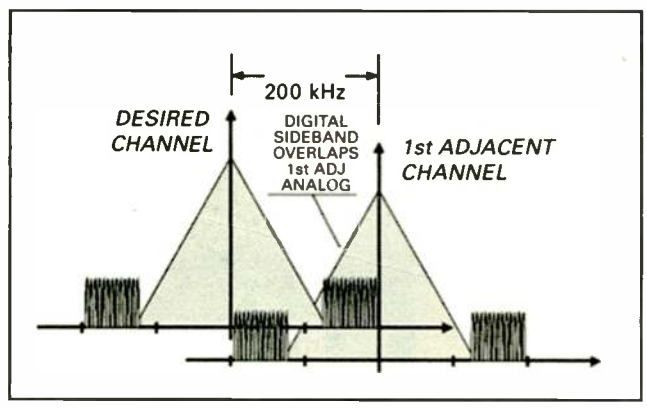
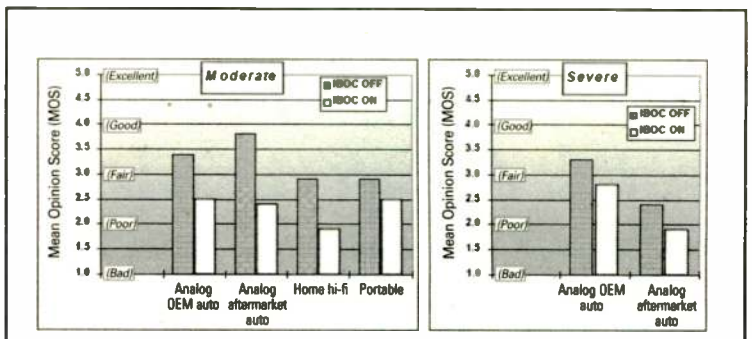


Fig. 2: First-Adjacent Hybrid Stations and Spectral Overlap



1st-adjacent compatibility – subjective evaluation results of audio recordings obtained in the field (speech programming)
Moderate: +16 to +6 dB D/U
Severe: +6 to –9 dB D/U

Fig. 3: Subjective MOS First-Adjacent Compatibility

Although this station meets the FCC's FM mask requirements, the transmitter does not even meet the new IBOC mask. This station caused significant second-adjacent interference to a distant station owned by the same company at a reception point within 3 to 4 miles of the IBOC transmitter.

The grunge — third bump from the center on either side of the center of the carrier — is typically caused by non-linearity in the transmitter. In another similar case, a station's grunge placed excessive energy on the first- and second-adjacent channels, which wiped out the receive signal of several translators transmitting from the same location. The fix was an expensive output bandpass filter for the offending transmitter.

Most manufacturers today use some type of output waveform feedback monitoring to reshape the wave into conformity, however the problem of excessive out of mask emissions is still an issue in many IBOC installations.

HOST COMPATIBILITY

Another first-adjacent issue is the possibility for IBOC to interfere with the host station's analog signal. While testing by the Advanced Television Technology Center (ATTC) showed that most car radios exhibited no measurable change in signal-to-noise when IBOC was added to the host signal, portable radios however, showed a reduction in signal-to-noise

SEE CONTOURS, PAGE 10

Feature packed.

(Kind of like our ads.)

Go (con)figure • [illegible]

Who are these guys? • [illegible]

Perfect timing • You can't have too much time. That's why Element's control display contains **four different chronometers**: a digital time-of-day readout that you can slave to an NTP (Network Time Protocol) server, an elapsed-time event timer, an adjustable count-down timer... and there's also that big, honkin' analog clock in the center of the screen (Big Ben chimes not included).

Screen play • Use any display screen you choose, to suit your space and decor. Get a space-saving [illegible] LCD, or go for a big 21" monster. (This is Dave Ramsey's favorite Element feature, by the way. Anyone want to bet he bought his monitors on sale?)

Lovely Rita • LED program meters? How 1990's. SVGA display has lots of room for timers, meters, annunciators and more — enough to show meters for all four main buses at once. Reboot to 5.1 surround mode and the light show is even cooler, with surround audio and associated stereo mixes all going at once.

Memory enhancer • We know how forgetful jocks can be. That's why Element remembers their favorite settings for them. Element's Show Profiles are like a "snap-shot" that saves sources, voice processing settings, monitor assignments and more for **instant recall**. Profiles are easy to make, too: just have talent set up the board the way they like it, then capture their preferences with a single click for later use. (Hey, make *them* do some work for a change.)

Black velvet • Some things **just feel right**. Like our premium, silky-smooth conductive plastic faders and aircraft quality switches. We build Element consoles with the most durable, reliable components in the industry — then we add special touches, like custom-molded plastic bezels that protect on/off switches from accidental activation and impact. Because we know how rough jocks can be on equipment. And nothing's more embarrassing than a sudden case of *broadcastus interruptus*.

Split decision • No, you're not seeing double: Element gives you the choice of single-frame or split-frame configurations of **up to 40 faders.** Perfect for complicated talk or morning shows where the producer wants his own mini-mixer, or to give talent space for copy, newspapers and such. Solomon would be proud.

Swap meet • Element modules hot-swap easily. In fact, the **entire console** hot-swaps — unplug it and audio keeps going; an external Studio Engine does all the mixing.

Stage hook • This button activates the emergency ejector seat. OK, not really. It's the Record Mode key; when you press it, Element is instantly ready to record off-air phone bits, interviews with guest callers, or remote talent drop-ins. One button press starts your record device, configures an off-air mix-minus and sends a split feed (host on one side, guest on the other) to the record bus. Like nearly everything about Element, Record Mode is **completely configurable** — its behavior can even be customized for individual jocks. Sweeeet.

How many? • How many engineers does it take to change these light bulbs? None... they're LEDs.

Talk to me • Need some one-on-one time with your talent? Talk to studio guests, remote talent, phone callers — **talk back to anyone** just by pushing a button.

The Busy Box for jocks • Element comes standard with a lot of cool production-room goodies you'd pay extra for with other consoles, like per-fader EQ, aux sends and returns and custom voice processing by Omnia™, enabling you to quickly build and capture compression, noise gating and de-essing combinations for **each and every jock** that load automatically when they recall their personal Show Profiles. Context sensitive SoftKnobs let production gurus easily tweak these settings, while simultaneously satisfying their tactile fixations. (Don't worry: for on-air use, you can turn off access to all that EQ stuff.)

Missing features • Did we forget something? Program these **custom button panels** with any macro you want, from recorder start/stop to one-touch activation of complex routing and scene changes using PathfinderPC™ software. You could probably even program one to start the coffee machine (black, no sugar, thanks).

Mix-plus • If constructing a complicated mix-minus on-the-fly brings a big grin to your face, you're excused. But if you're like us, you'll love the fact that Element does mix-minus **automagically**. Forget using all your buses for a four-person call in, or scrambling to set up last minute interviews. When you put remote codecs or phone calls on air, Element figures out who should hear what and gives it to 'em – as many custom mix-minuses as you have faders.

Great Phones • With Element, jocks never have to take their eyes or hands off the board to use the phones. Element works with any phone system, but really clicks with the Telos Series 2101, TWOx12, and new NX-12 that connects four hybrids plus control with a **single Ethernet cable.** StatusSymbols™ (cool little information icons) tell talent at a glance whether a line is in use, busy, pre-screened, locked on air, etc. Even dial out with the built-in keypad.

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Contours

CONTINUED FROM PAGE 8

from 3 to 12 dB. After turning on IBOC, many stations have reported that their analog air monitors exhibit white noise in the background.

Perhaps the most serious threat to the hosting station is when dual antennas are used.

The new FCC rules now allow the use of a separate antenna for IBOC transmission with a simple letter of notification. The IBOC antenna, however, must be licensed as an auxiliary station, located within 70 percent of the height of the center of the primary antenna and within 3 seconds of latitude or longitude. While often a less expensive way to add IBOC to a station, the use of dual antennas can result in significant interference to the host station.

For example, as reported in RWEE ("KNOW IBOC: Space-Combined Antenna Match Is Key," Oct. 17), a station located in a populated area of Minneapolis turned on its IBOC using a separate antenna and was surprised to find the HD operation caused severe interference to the hosting analog station within a 2 mile area. The host station was its bread and butter, so station engineers quickly turned off the IBOC, took down the antenna and installed a high-level combined system, which eliminated the interference.

Another station reported that a listener within a mile and within sight of its tower could no longer receive the station due to its own HD interference. The vertical elevation field graphs show why (see Fig. 6). Note that these graphs are for a 12-bay main analog antenna and a two-bay IBOC antenna.

The table in Fig. 7 shows that the radiated power ratio of IBOC to analog is not maintained at –20 dBc along various vertical angles and horizontal distances from the antenna. Note that while the ratio of analog to IBOC power should be 100 to 1, this ratio was not fully obtained until the listener was in the main lobe of the 12-bay antenna.

Anecdotally, in early data, NPR engineers have found that some dual antenna systems also do not perform as well at greater distances.

Fig. 5: Spectrum Analyzer Capture of a System With 'Grunge'

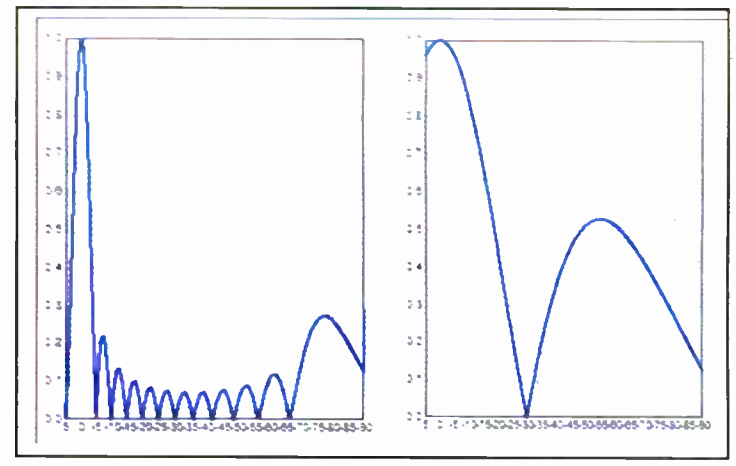

Fig. 6: Vertical Elevation Field Graphs, 12 Bay vs. 2 Bay

Angle in Degrees	Analog % Field 12 bay	IBOC % Field 2 Bay	Distance in feet	Analog to HD Ratio
0	100	1	~	100 1
-5	10	0 95	11,430	1 0 9
-12	13 5	0 80	4,701	2 8 1
-27	7 5	0 5	1,963	2 3 1
-55	10	0 53	700	4 1

Fig. 7: Vertical Elevation Power Ratio Table

U/D Ratios for Hybrid Into Analog

1999 NAB Tests of 8 Analog Auto Receivers Undesired to Desired (U/D) ratios (Analog → Analog)

Co-channel	–38 dB U/D	(FCC –20 dB)
First Adj.	–7.5 dB U/D	(FCC –6 dB)
Second Adj.	+42 dB U/D	(FCC +40 dB)
Third Adj.	+43 dB U/D	(FCC +40 dB)

NAB and ATTC 2001 HD Tests Undesired to Desired (U/D) (Analog → Hybrid)

Co-channel	–38 dB U/D
First Adj.	–3 dB U/D
Second Adj.	+42 dB U/D
Third Adj.	+43 dB U/D

Derived from ATTC, Undesired to Desired (U/D) (Hybrid → Hybrid)

Co-channel	–2 dB U/D
First Adj.	+29 dB U/D
Second Adj.	+64 dB U/D
Third Adj.	N/A

ANALYZING REAL-LIFE IBOC INTERFERENCE

Recently, I put a post on several broadcasting-related Internet list servers requesting that people report to me any real cases of IBOC interference either caused or received. I was somewhat surprised by the volume of responses received.

Due to constraints in space, what follows represents only a few of the cases reported. We will take these real-life examples and analyze the extent of the interference by using Longley-Rice and a prediction model based on undesired-to-desired ratios gleaned from the existing receiver studies.

These U/D values were set at the point where adjacent interference just becomes noticeable (a 5 dB decrease in the signal-to-noise ratio). The FCC contour protections afforded between analog stations are shown in parentheses as a comparison.

As an example of how this works, take the case of an analog station that has a 60 dBu signal at a given location (desired), and another first-adjacent station operating hybrid IBOC has a 57 dBu signal at the same location (undesired). The hybrid-into-analog table shows that interference will occur because the U/D ratio is –3 dB (See NAB and ATTC 2001 HD Tests results for first-adjacent receiver performance in sidebar).

These and the U/D ratios to follow for hybrid-into-analog and hybrid-into-hybrid were used to develop the predictions of the interference shown graphically on the V-Soft Communications Probe 3 maps.

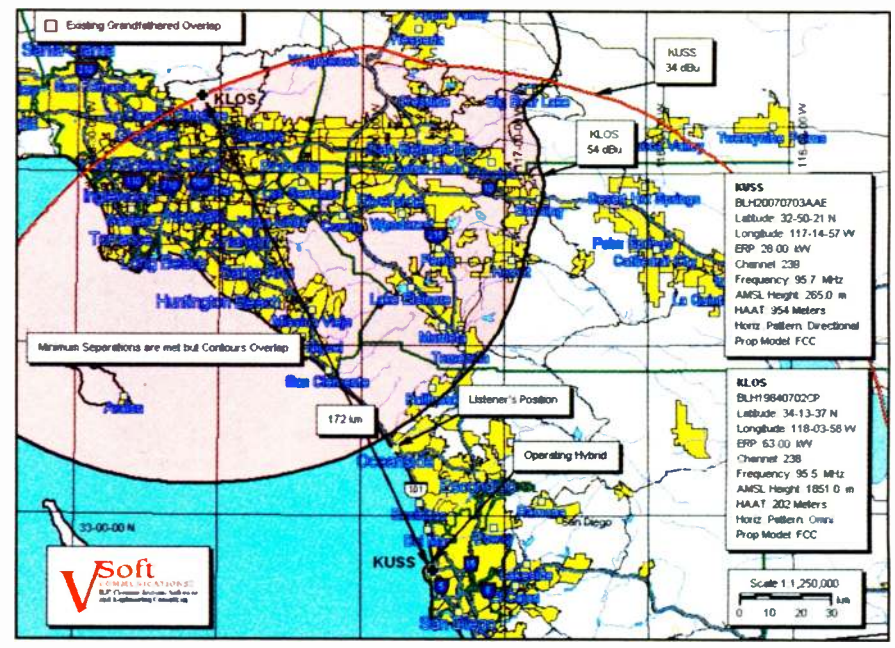

Fig. 8: Minimum separations are met but contours overlap.

The U/D ratios for hybrid into analog were derived through NAB/ATTC tests and other available analysis including the work done by Sid Shumate. (See U/D results in sidebar.)

KUSS CASE STUDY

In the first case of reported first-adjacent IBOC interference (see Fig. 8), an Oceanside listener to Los Angeles' KLOS(FM) complained that when KUSS(FM) in Carlsbad started transmitting with hybrid IBOC, all listening to KLOS ceased in the listener's area. The interference was described by the listener as "a steady carrier hiss."

SEE CONTOURS, PAGE 12

rubicon

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Contours

CONTINUED FROM PAGE 10

In this case, there is no short-spacing between KLOS and KUSS. The FCC minimum spacing rules under Section 73.207 requires that first-adjacent Class B (commercial) stations KUSS and KLOS must be at least 169 kilometers apart. In fact, the distance between the stations is nearly 172 km. So why does this interference exist?

When we look deeper we find that, many cases of stations in the FCC database that meet the FCC minimum spacing, but that also have contour overlap. Many of these cases are in Zone B grandfathers that stem from the early days at the FCC when class caps were not enforced and a moderate degree of contour overlap could be ignored if it would give a high population area a new radio service.

Others are caused by high-vantage antennas that send interfering signals much further than the FCC anticipated when they established the minimum spacing table. It's

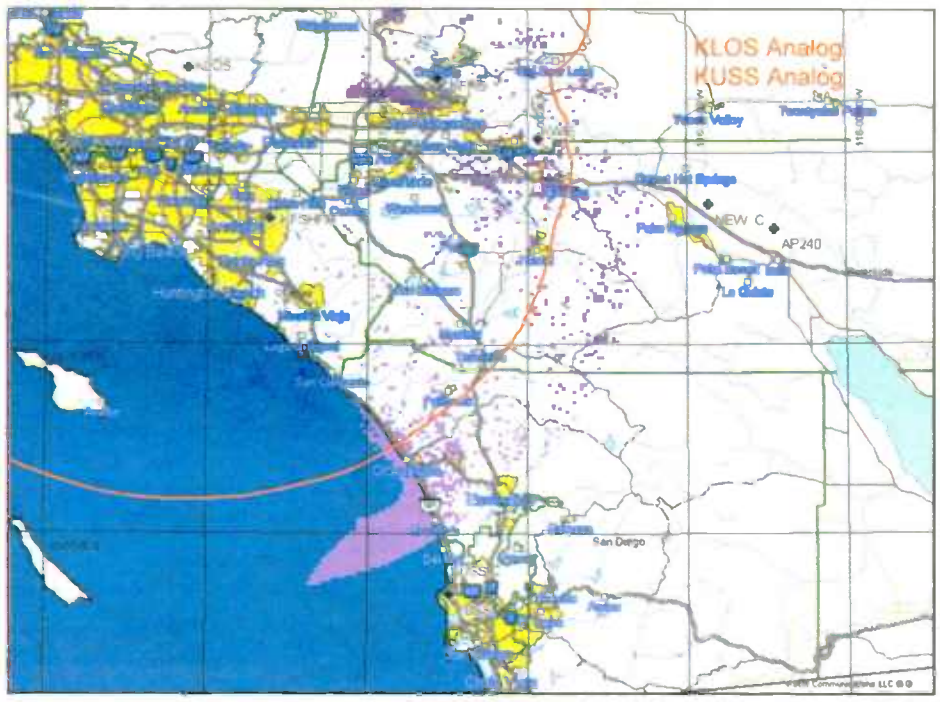

Fig. 9: KLOS Analog With KUSS Analog (Interference Base)

KLOS is a grandfathered over-power Class B. With its antenna of 954 meters HAAT (804 meters above the class maximum of 150 meters) and its 63 kW (13 kW above the class maximum), this station has a blockbuster signal. So while KUSS meets the minimum separation distance under the rules it does not have to protect the KLOS normally protected 54 dBu signal contour. As a consequence, the KLOS protected contour is seriously overlapped by the KUSS interference contour.

In addition to this situation, there are likely that between grandfathered superpower stations, short-spaced stations and terrain elevation-favored stations, at least 10 percent of our existing assignments will fall into this category. So, even without being short-spaced, if the protected and interfering contours of two stations overlap, IBOC interference to analog is likely to be created.

On the map shown in Fig. 9, KLOS is transmitting in analog. The other stations also are analog including KUSS. The interference area in light violet is caused by KUSS when operating in analog. The darker purple is interference caused to KLOS by another station and for this example can be ignored.

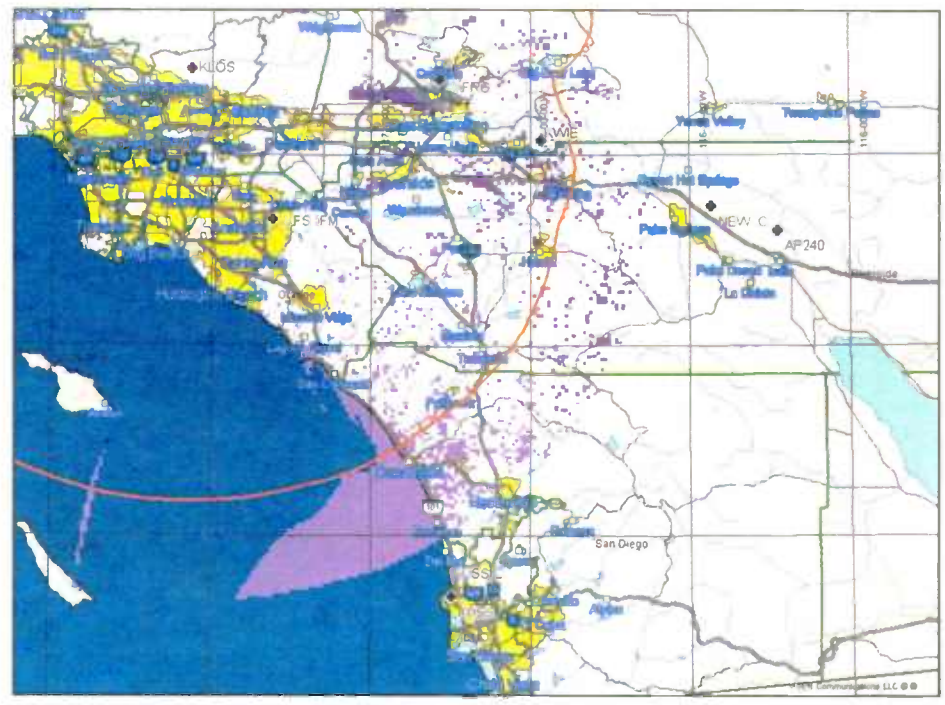

Fig. 10: KLOS Analog With KUSS Hybrid Digital

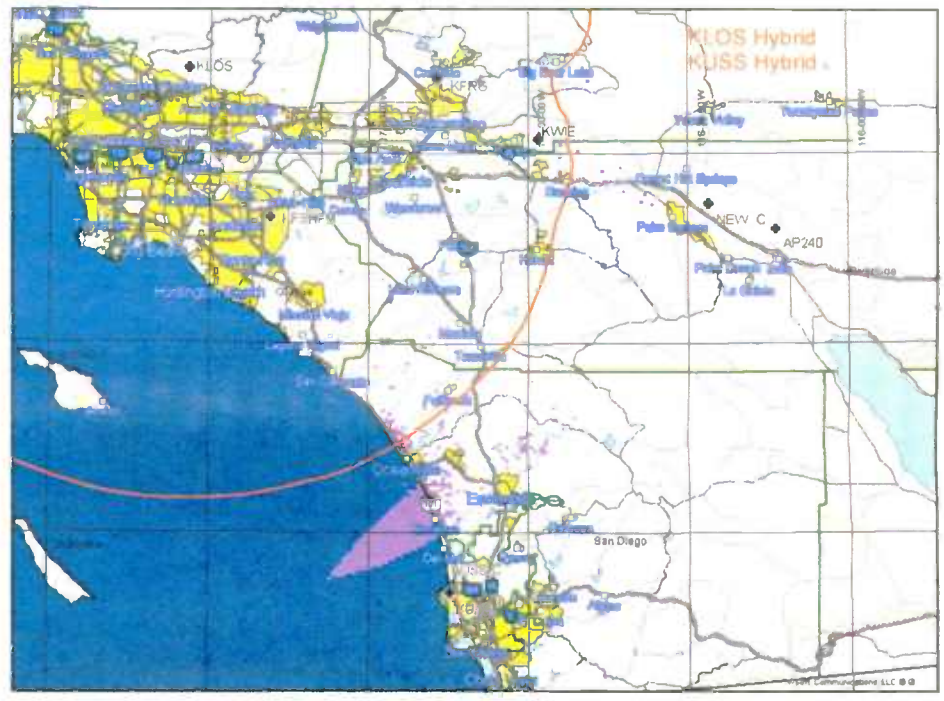

Fig. 11: KLOS Hybrid and KUSS Hybrid Digital

On the map shown in Fig. 10, KLOS is transmitting in analog and KUSS is being shown with its hybrid operation. Notice the additional interference within the KLOS protected 54 dBu contour ... and particularly the new interference up the coast.

On the map shown in Fig. 11, KLOS is transmitting in hybrid and KUSS also is hybrid. The interference area is caused by KUSS operating in the hybrid mode. Note that the extent of digital-to-digital interference is much less than all other interference varieties.

WDEK CASE STUDY

In the next case of reported IBOC interference, we find that the first-adjacent Class B stations WDEK(FM) and WPWX(FM), located near Chicago, are short-spaced.

WDEK receives IBOC interference from WPWX. On its first-adjacent, WPWX should be 169 kilometers apart from WDEK, but it's only 105.6 kilometers from WDEK. WPWX operates with a directional antenna to protect WDEK, but even so, the FCC protected and interference contours cross significantly.

The map in Fig.12 shows a plot of interference to the fringe area of WDEK with all the surrounding stations, including WPWX

SEE CONTOURS, PAGE 14

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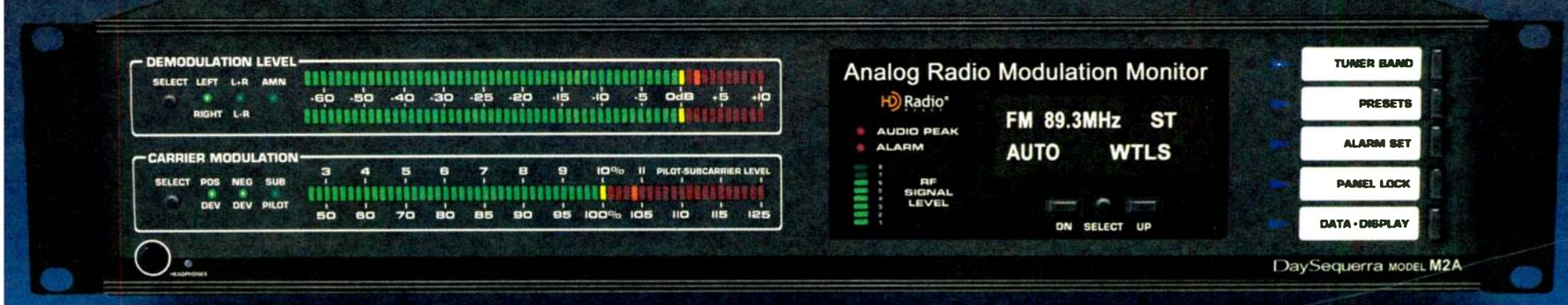

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Contours

CONTINUED FROM PAGE 12

operating in the analog mode. So this is a "before" IBOC picture. The area in red is the area of predicted interference from WPWX to WDEK. Nearly all of this is outside the 54 dBu FCC protected contour, which also is shown in red.

In Fig. 13, WDEK is shown operating in analog, and the other stations operate in analog except for WPWX, which operates in hybrid digital. The red-colored interference area is increased to WDEK, including areas within its protected 54 dBu contour.

In Fig.14, WDEK operates in analog and the other stations operate in hybrid. This slide represents the most interference to WDEK.

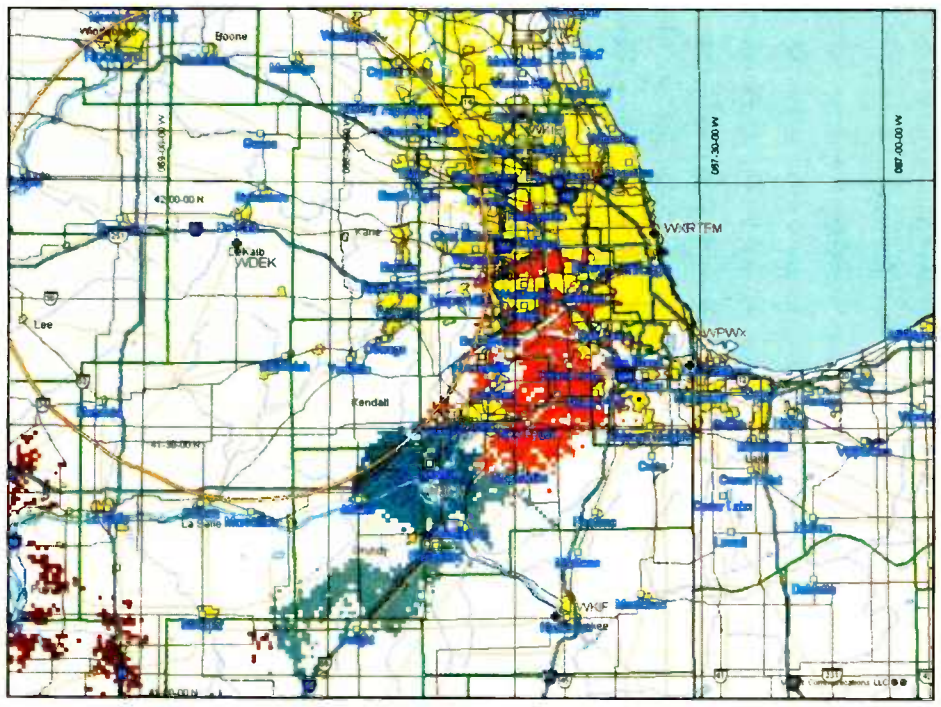

Fig. 12: WDEK Analog and All Other Stations Analog (Interference Base)

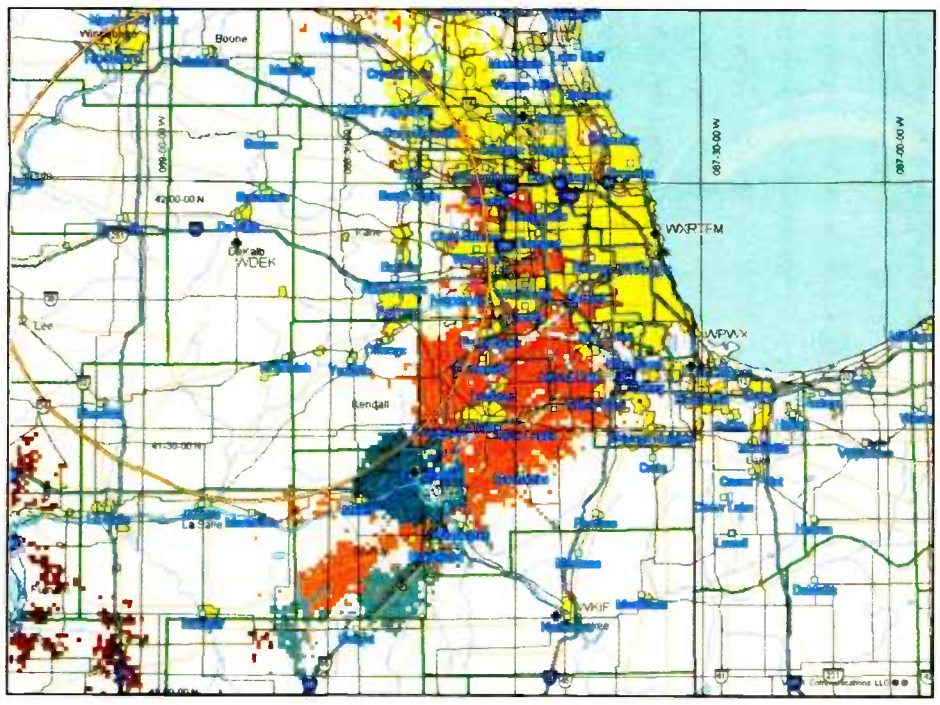

Fig. 13: WDEK Analog and WPWX Hybrid Digital, All Other Stations Analog

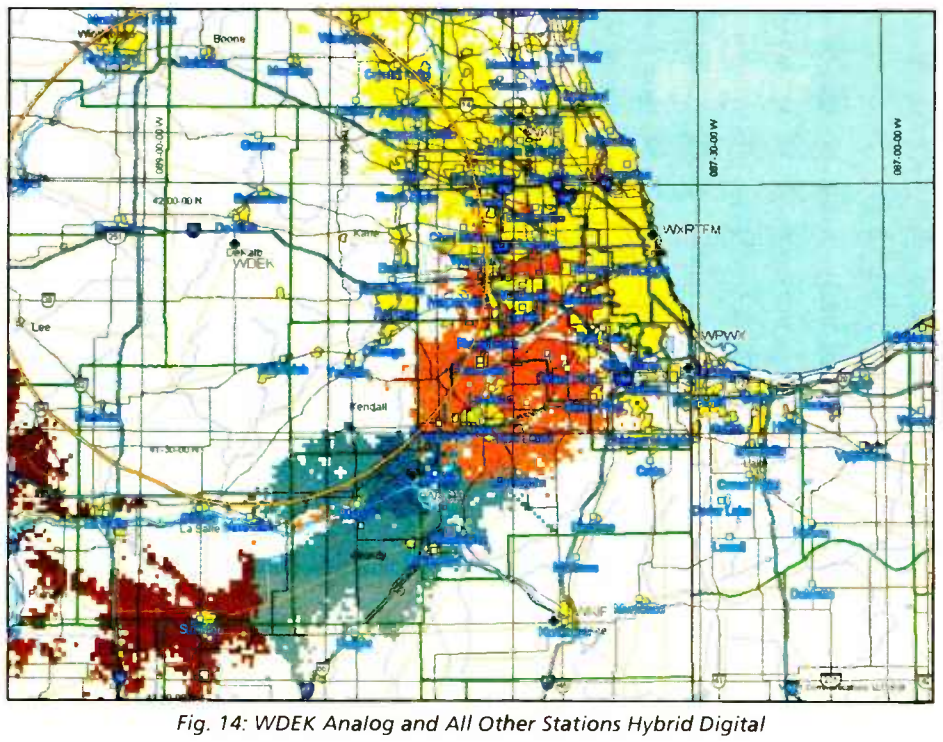

Fig. 14: WDEK Analog and All Other Stations Hybrid Digital

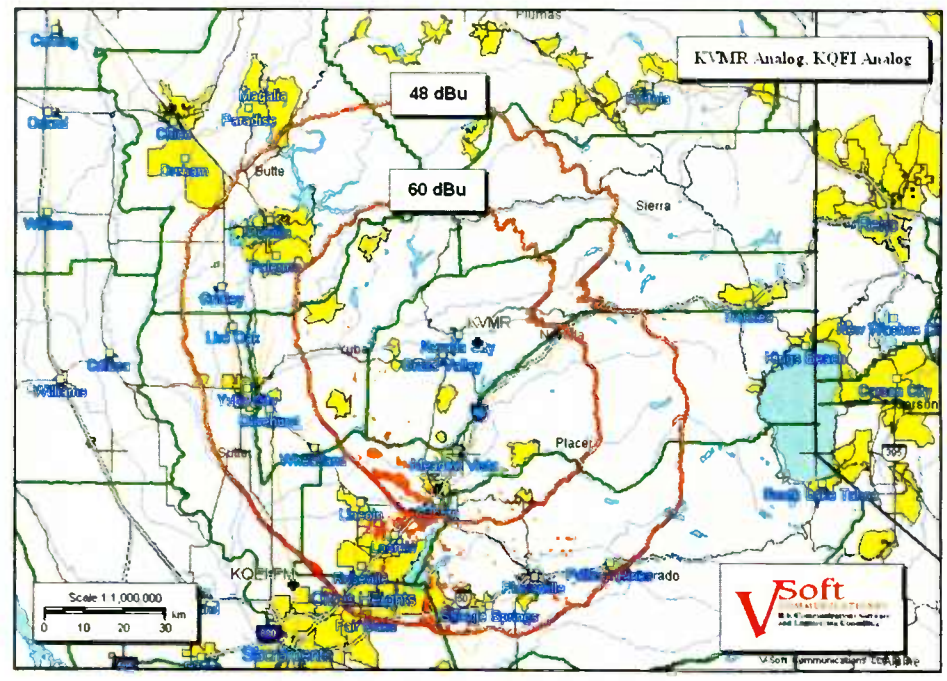

Fig. 15: KVMR Analog With KQEI Analog

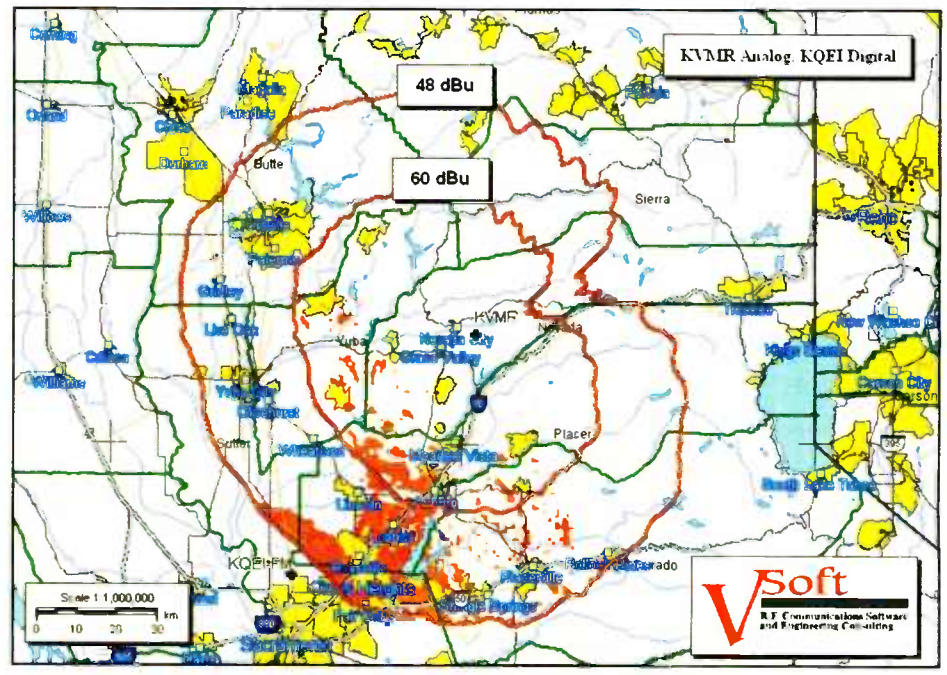

Fig. 16: KVMR Analog With KQEI Hybrid Digital

NON-COMM EDUCATIONAL CASE STUDY

The next set of maps shows a case of interference between two non-commercial stations operating in the reserved educational band. Here, the allocation system is not based on minimum separations between stations, but on contour-to-contour protections. Under the FCC Rules for first-adjacent stations, the 60 dBu protected contour must not be crossed by the 54 dBu interference contours of adjacent stations.

The map in Fig. 15 shows the existing interference areas to KVMR(FM), Nevada City, caused by KQEI(FM). While some interference is depicted, the northern Sacramento area is relatively free of interference.

However, as we can see from Fig. 16, this allocation does not prevent IBOC interference. The map shows the large amount of interference caused within the 48 and 60 dBu of KVMR by KQEI's hybrid operation. The area is now void of KVMR listeners where the station once claimed an audience and membership.

Though many non-commercial stations and commercial stations have sizable numbers of listeners beyond the protected contour, that audience is not prevented from receiving interference under FCC rules. If there are listeners out there they only exist as long as there is no interference. However, as we can see from this case, not only did KVMR lose its listeners outside of the 60 dBu, but many listeners were lost within the normally protected contour.

So, why does this happen? If we look at the contour relationship between the KQEI interference contour and the KVMR stations we find that the FCC allocation system shows no contour overlap. The answer is the FCC's non-commercial allocation system is quite blind of distances beyond 10 miles from the station because it only considers terrain from 3.16 to 16 kilometers from the transmitter.

What you do not see in these maps is the actual underlying terrain. In fact, the path from the KQEI transmitter (Fig. 17) is direct and without obstructions; however the path from KVMR (Fig. 18) to the area of its lost coverage is rife with rugged peaks that attenuate its signal. The line of sight in these figures is the blue line, while the terrain elevations are graphed in green. The orange line is the 60 percent Fresnel zone, which for best non-multipath reception should not be intruded by terrain.

SECOND-ADJACENT INTERFERENCE

Yes, you are correct; there has been no discussion of second-adjacent FM IBOC-to-analog interference. We really do not have much data on second-adjacent interference; however, we can say it is definitely not as problematic as first-adjacent interference.

The NRSC studied second-adjacent interference and came to the conclusion that a limited number of home type receivers may experience impact for +30 to

SEE CONTOURS, PAGE 16

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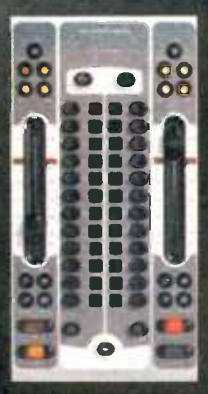

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by Steve Callahan

For Thomas, All Roads Lead to Radio

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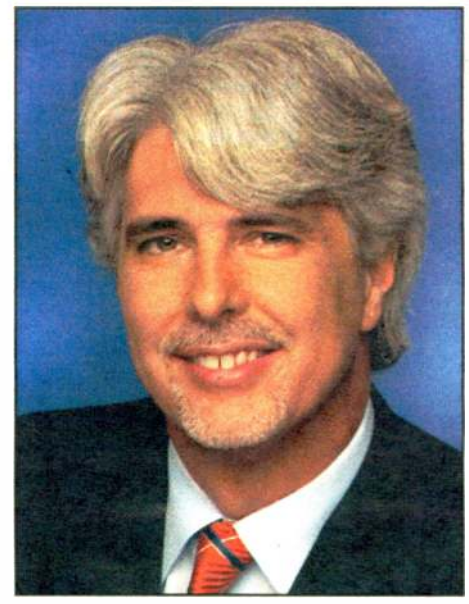

Barry Thomas

When Barry Thomas was six years old, he was fascinated by TV towers near his hometown of Dillon, S.C. That fascination led to a part-time position at WNOK(AM), Columbia, where Thomas had the chance to do a variety of jobs at the station, eventually becoming chief engineer there.

Thomas has worked in all aspects of the radio engineering business, from consultant to vice president of engineering, working his way up to increasingly larger groups and markets. From South Carolina Thomas moved to Atlanta, then Cleveland, where he was director of engineering for OmniAmerica Group working with legendary stations WHK, WMMS and WMJI. After that, he worked for AMFM/Chancellor Media in San Francisco and Los Angeles, where once again he designed and built new facilities for stations KCMG(FM) and KYLD(FM).

At the same time Thomas worked as a contractor, assisting in projects such as network distribution and remote broadcasts under the banner of Thomas Media Systems and Design. After a couple of stints working with Internet radio, he returned to the radio business as vice president of engineering at Westwood One Radio Networks, the largest radio network in the United States. Recently, in 2006, Thomas became vice president of engineering, radio, for Lincoln Financial Media Group.

While Thomas helped to start SBE Chapter 101 in Columbia in 1986, he probably couldn't have imagined that in 2007 he would be elected president of the Society of Broadcast Engineers. He shares with RW-EE details of his career, his direction for the SBE during his term and his dedication to giving something back to the broadcasting industry.

How did you first get interested in radio?

I'm told I was exceptionally taken by a radio station tour when I was 6. I do remember being fascinated as a child by some TV towers near my hometown of Dillon, S.C. Later I grew into a fascinated listener and then someone dedicated to working in the business. I still maintain that excitement about what we're doing.

Tell us about your first job in the business.

News and fill-in at WNOK, a 1,000-watt AM station in Columbia. At the time I was offered more responsibility than I could take with high school so I didn't really get going until a few years later when I worked at the station and its companion FM while going to college. I did weekend religious programming, remotes, pulled copy, board-opped the morning show, ran air shifts, helped the engineer — whatever I could to work in the business.

I worked through traffic, programming, even a little sales until landing the chief engineer's job just ahead of a major rebuild. I have to tell you I must thank my first general manager, Bill McElveen, for giving me the shot and suffering through my significant growing pains as I learned my craft.

When did you realize you wanted to pursue engineering as a career?

Once I got involved with WNOK through one of the station engineers who worked with my school, I knew I was going to be involved in some way in broadcast engineering. To my friend's credit he did spend a lot of time telling me how difficult my career would be, but I was determined. I think any of us who start in the business have a tinge of an aspiration to be on the air, but I pretty quickly discovered that my passion was making the magic work.

The final tipping point was when I was offered the chief's job and given the responsibility to complete a facility rebuild started by the previous chief. It was at that point that I moved from doing whatever I could to be involved in radio to dedicating myself 100 percent to this career.

SEE THOMAS, PAGE 18

Contours

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+40 U/D ratios and higher. (The undesired station can be 30 to 40+ dB above the desired station when interference occurs.)

CONCLUSION

What we have done with the introduction of IBOC is to superimpose a new transmission method over an existing allocation system, hoping it will work. In many cases it does; but there are more cases coming to light every day where there are problems.

With only a small percentage of stations converted to IBOC, do we need to be thinking about what listening will be like when all or nearly all stations are transmitting IBOC? Does this ring the death knell for quality analog FM as we know it? What will the widely discussed increase in the IBOC injection level from 1 percent to 10 percent do to interference levels? Should we set a date sooner than later for the demise of analog broadcasting?

There are still those who say, "Don't look a gift horse in the mouth"; the FCC gave us the use of this new spectrum, so let's make the best of it. Being neighborly to the stations and their listeners adjacent to your FM channel seems to have taken the back seat over a more hedonistic view of "Let's push on and make amends for what we have done later."

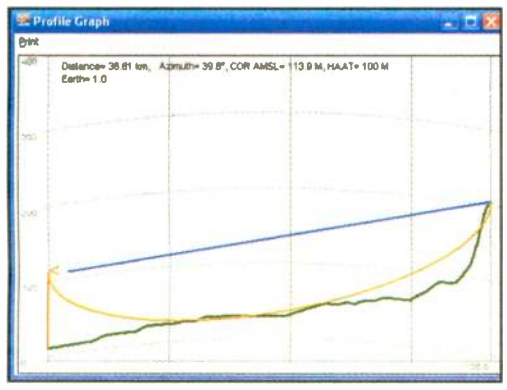

Fig. 17: Terrain Profile Path From KQEI to an Interference Point

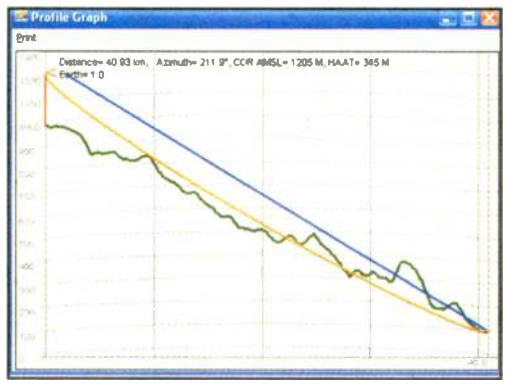

Fig. 18: Terrain Profile Path From KVMR to an Interference Point

Concerned about the impact on public radio listening, the Corporation for Public Broadcasting has funded a wide-sweeping study on the impact of IBOC on existing public radio coverage and interference levels. (My role in this project was to author the technical RFP; I presently serve as CPB technical liaison for the project, now being carried out by NPR Labs.) The outcome of this research will consider how the current batch of analog and digital radios fare in this new interference environment. It also will provide the first up-to-date information about the problem issues of the coexistence of analog FM and IBOC that we have had in five years.

The report, due at the end of this year, will be instrumental in plotting the path of "where we go from here."

Doug Vernier is the president of V-Soft Communications. He was profiled in the Aug. 23, 2006, issue of RW Engineering Extra. ■

JUST ENOUGH TEST

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The ML1 is a full function high performance audio analyzer and signal monitor that fits in the palm of your hand. The comprehensive feature set includes standard measurements of level, frequency and THD+N, but also VU+PPM meter mode, scope mode, a 1/3 octave analyzer and the ability to acquire, measure and display external sweeps of frequency response generated by the MR1 or other external generator.

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- Measure signal balance error
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With all the power and digital audio measurement functions of more expensive instruments, the DL1 analyzes and measures both the digital carrier signal (AES/EBU, SPDIF or ADAT) as well as the embedded audio. In addition, the DL1 functions as a smart monitor and meter for tracking down signals around the studio. Plugged into either an analog or digital signal line, it automatically detects and measures digital signals or informs if you are on an analog line. In addition to customary audio, carrier and status bit measurements, the DL1 also includes a sophisticated event logging capability.

- AES/EBU, SPDIF, ADAT signals
- 32k to 96k digital sample rates
- Measure digital carrier level, frequency
- Status/User bits
- Event logging
- Bit statistics
- VU + PPM level meter for the embedded audio
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Acoustics & Intelligibility analyzer

The AL1 Acoustilyzer is the newest member of the Minstruments family, featuring extensive acoustical measurement capabilities as well as core analog audio electrical measurements such as level, frequency and THD+N. With both true RTA and high resolution FFT capability, the AL1 also measures delay and reverberation times. With the optional STI-PA Speech Intelligibility function, rapid and convenient standardized "one-number" intelligibility measurements may be made on all types of sound systems, from venue sound reinforcement to regulated "life and safety" audio systems.

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- Required for the Acoustilyzer; optional for the Minilyzer

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and PC software

Add the MiniLINK USB interface and Windows software to any ML1 or DL1 analyzer to add both display and storage of measurement results to the PC and control from the PC. Individual measurements and sweeps are captured and stored on the instrument and may be uploaded to the PC. When connected to the PC the analyzer is powered via the USB interface to conserve battery power. Another feature of MiniLINK is instant online firmware updates and feature additions from the NTI web site via the USB interface and your internet-connected PC.

- USB interface fits any ML1 or DL1
- Powers analyzer via USB when connected
- Enables data storage in analyzer for later upload to PC
- Display real time measurements and plots on the PC
- Control the analyzer from the PC
- Firmware updates via PC
- MiniLINK USB interface is standard on AL1 Acoustilyzer

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Thomas

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A few years later I had another epiphany when I took my parents around the new FM transmitter site we'd built. Their attitude was, in spite of my dedication, that eventually I would grow out of this radio thing. That stopped when they saw a room full of equipment like nothing they had ever seen and my maintenance logs and notes, and realized this work required real skills. I believe my mother said, "Where did you learn about all this?"

Tell us about an engineering project of which you are particularly proud.

The studio projects in San Francisco, KYLD(FM), and Los Angeles, KCMG(FM), are two of my proudest complete facility projects, but my participation in the Clear Channel Satellite Services/Premiere Radio Networks L.A. Network Operations Center, Premiere Radio Network's audio streaming and archiving system, and the many projects at Westwood One — including 2004 CBS Election coverage, the '06 Olympics and the Kennedy Space Center leading up to the first shuttle launch after Columbia — all are incredible achievements, although they are not as easily captured in photos.

What is your current job?

I am vice president of engineering for Lincoln Financial Media's Radio division, formerly Jefferson-Pilot Communications. We own radio stations in Atlanta, Charlotte, N.C., Denver, Miami and San Diego, and TV stations in Charlotte, Richmond, Va., and Charleston.

As VP of engineering I am responsible for the technical support operations at all of our stations. I work closely with the Lincoln Financial Media IT division, which support both TV and radio, and coordinate the exceptional talent of our engineering directors in the five markets.

What road led you to the presidency of the SBE?

I admit to a certain amount of self-interest at the start. I helped create the Columbia SBE Chapter 101 in 1986 because I wanted to get certified because the FCC was phasing out licensing. Since then I've learned the incredible advantages of membership and participation in this great organization.

I found that, through SBE, I had a connection to 5,000 other incredibly skilled and gifted professionals. I've always been one to seek out people who know the most and learn from them at every opportunity. For example, Glen Clark spent hours teaching me about AM antennas, and Doug Howland took me under his wing and taught me the real difference between large- and major-market operations.

In 1990, Paul Donahue counseled me to move to Cleveland and go through the incredible engineering boot camp that is that market. Richard Rudman taught me about public warnings; Greg Ogonowski just let me work nearby so I could soak up his stray brilliance. The list goes on and on. SBE offers me a connection to incredible people like that.

As I worked in different markets and learned more, I became keenly aware that I needed that connection and wanted to offer the same education to those who followed me.

I think any of us who start in the business have just a tinge of an aspiration to be on the air, but I pretty quickly discovered that my passion was making the magic work.

I also served at the SBE Chapter level wherever I could and on the SBE National Board for a number of years. This year I have been part of the group that has worked to benefit WUVT(FM)/Virginia Tech on behalf of shooting victim and station engineer, Kevin Sterne.

For several years I served on the NAB Engineering Conference Committee, a group that is made up of NAB and SBE participants. I also spoke at the NAB [convention] a number of times, either as part of the SBE Ennes Educational Workshops; presenting to the NAB Broadcast Engineering Conference about interactive or emerging technologies; or moderating sessions.

I've written a number of times for trade press. The advice I always give for people to step up is to be active and get involved; in the chapter, in national committees, etc. Write for press — I know there is always a need for good writers — and participate in conferences.

I also craved a way to share my passion for the industry, and develop more ways we all can be recognized. SBE gives me a way to do all of that, as well as join with our shared strength to improve our profession and industry.

What is your number one goal for the SBE during your term?

Through the SBE we share the common purposes printed on the back of every membership card: to promote and advance the science of broadcast engineering; to establish standards of professional education, training and competence for members; to encourage the exchange of ideas and promote professional standards; and to represent the needs of members before regulators and the industry.

My number one goal is to assert and demonstrate our commitment to those purposes in everything we do.

The first of these purposes, "to promote

SEE THOMAS, PAGE 20

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Thomas

CONTINUED FROM PAGE 18

and advance the science of broadcast engineering," is the most significant, as it truly sums up the SBE's mission. We will do that best through our chapters. The majority of members derive value of the society through chapter participation. I want to work with our board of directors and membership to focus our efforts on helping chapters succeed and improving our profession through community.

What do you say to the engineer who is not yet a member of the SBE?

Why not? You're not working in a trade. You've chosen a profession; a great one with incredible history and an even more exciting future.

The SBE is the only organization specifically dedicated to promoting, educating and certifying the members of your profession, the working broadcast engineer. Participation in this group demonstrates your commitment to your profession.

Membership allows you to share your experience; learn and grow with your colleagues; and pool our shared resources to improve our industry and develop greater recognition. Why wouldn't you want to be part of our shared efforts to ensure that you have access to the best information, greatest skill and a collective group of people who really understand what you're going through?

One of the most frequent excuses I hear from older non-members is, "I don't need to prove I know what know. I don't need SBE certification, I don't need SBE education." I can't tell you how selfish and short-sighted that perspective is. Those who complain that our field is declining and do not participate are contributing to its decline by not participating in an organization created just to support and promote them. The profession needs them to pass their vast experiences on to the next generation.

What do you think local radio engineering is going to look like in five years?

That's an interesting question. I can't imagine it will be materially different than it is today, with the exception that the local engineer will have less RF background. It has become an IT world. This is not a bad thing; it just has.

As an engineering manager, what is the biggest issue you will be facing this year?

Anticipating the needs of our stations and responding quickly with creative solutions to their problems. We are in a customer service profession. We're the people who, when asked if something can be done, must provide the way to do it. Considering the economy and media spending, stations will be working to find more ways to leverage their products and brands, and maintain penetration and profitability. Those new ways will invariably require technology to support them. We've got to be fast on our feet and provide the answers.

As one GM I worked with said, "Don't tell me how it can't be done; tell me how it *can* be done." It sounds like a simple platitude but it's actually a fundamental shift in perspective that's important to being part of a team.

Where are the radio engineers of tomorrow coming from?

The IT world. Like it or not. We've hit the end of a long phase of attrition because stations are running as lean as they can. What we're seeing now, though, is an "engineer" job loss often offset by an "IT-based" technology staff addition. This is significant. As distribution of radio products move across platforms, delivery of those products will be done using computer networks, not just RF transmitters.

If you had not pursued your present career, what would you be doing instead?

Some time ago I drifted from being a "working" broadcast engineer into broadcast equipment sales and came back shortly thereafter because I realized that this is not just what I do but it's what I am. I love what I do and the people I get to work with and learn from. I've worked in so many facets of the industry and know there are many more as our technology changes.

Of course I can dream of being a sailing ship's captain, an actor, a singer; but that's another life, one I would play on "Fantasy Island" while still working with the island radio station.

In 1987 I felt like I had topped out in Columbia, after doing all I could at WNOK and building a new sister station in Hilton Head — then WHTK(FM), Port Royal — so I tried working as a broadcast equipment seller for a couple of years, employed by the fine folks at Broadcasters General Store. I proved to myself I could do that, but I was never as happy as when I was solving problems and supporting the creative products on radio.

This was an incredible experience made even better by being able to hang out with Glen Clark after work and learn AM. Again, drifting back to radio. Looking back, I understand what made that situation a difficult fit for me. It wasn't sales, per se, but something much more complex. I appreciate the opportunity that BGS gave me, however, and continue to be an appreciative customer.

When you're not working, what do you do for fun?

At one time I raced sailboats and rode motorcycles. Now I have four-year-old twins. What little time I have I tinker with my basement radio studio — complete with PR&E ABX — or do something to ruin my home computer network and then learn how to fix it.

Steve Callahan is the director of engineering for Rhode Island Public Radio. ■

READER'S FORUM

Open Minds (and Ears) to Sonic Spaces

I read an article, "Social Spatiality Belongs in Radio Broadcasting" (Dec. 13, 2006) where Barry Blesser notes that radio needs more "soundscapes."

At first, I thought it might be an academic discussion about aural concepts. But, the more I read his article, the more I agreed with him.

His argument is that sound never occurs in a vacuum; that is, sound requires action. Even if blindfolded, your ears can tell you a lot about your surroundings. The natural sound helps define the experience.

In broadcast radio, he says, "unintentionally, and perhaps in the name of audio quality, the aural experience is stripped of special and social context, which often has as much emotional impact as the content."

There are exceptions, of course, like radio dramas that featured effects designed to create "aural landscapes." And sports events, where the sound of the crowd, the crack of the bat or other sounds of the game add immeasurably in transporting the listener to the event.

I think also of Clyde Clifford's "Beaker Street" program on KAAY(AM), where mysterious music was used to mask the sound of the transmitter noise, but became an integral part of the listening experience.

In normal everyday radio, however, we tend to remove all natural sound. In the beginning of radio, this may have been done to increase intelligibility, but that hasn't been a problem for years.

I remember a few years ago, when Jerrell Shepherd removed all the glass from his on-air studios. He wanted the listener to hear the sound of a working radio station whenever the mic was opened. Though it went against everything I had ever been taught, I kinda liked the idea.

Whenever I hosted a "Bids for Bargains" type show, I always made sure that the audience could clearly hear the phones ringing, people talking, lots of noise and fun. I always thought that added to the listening experience.

Television has embraced the idea of creating a "social space," even by sending a reporter to the scene of an event, and creating the scene with sound and pictures.

Blesser suggests that 21st century broadcasters can create whole new experiences if they will open their minds, and ears, to creating "sonic spaces" on radio. I think it's a marvelous idea.

Art Morris
Aurora, Mo.

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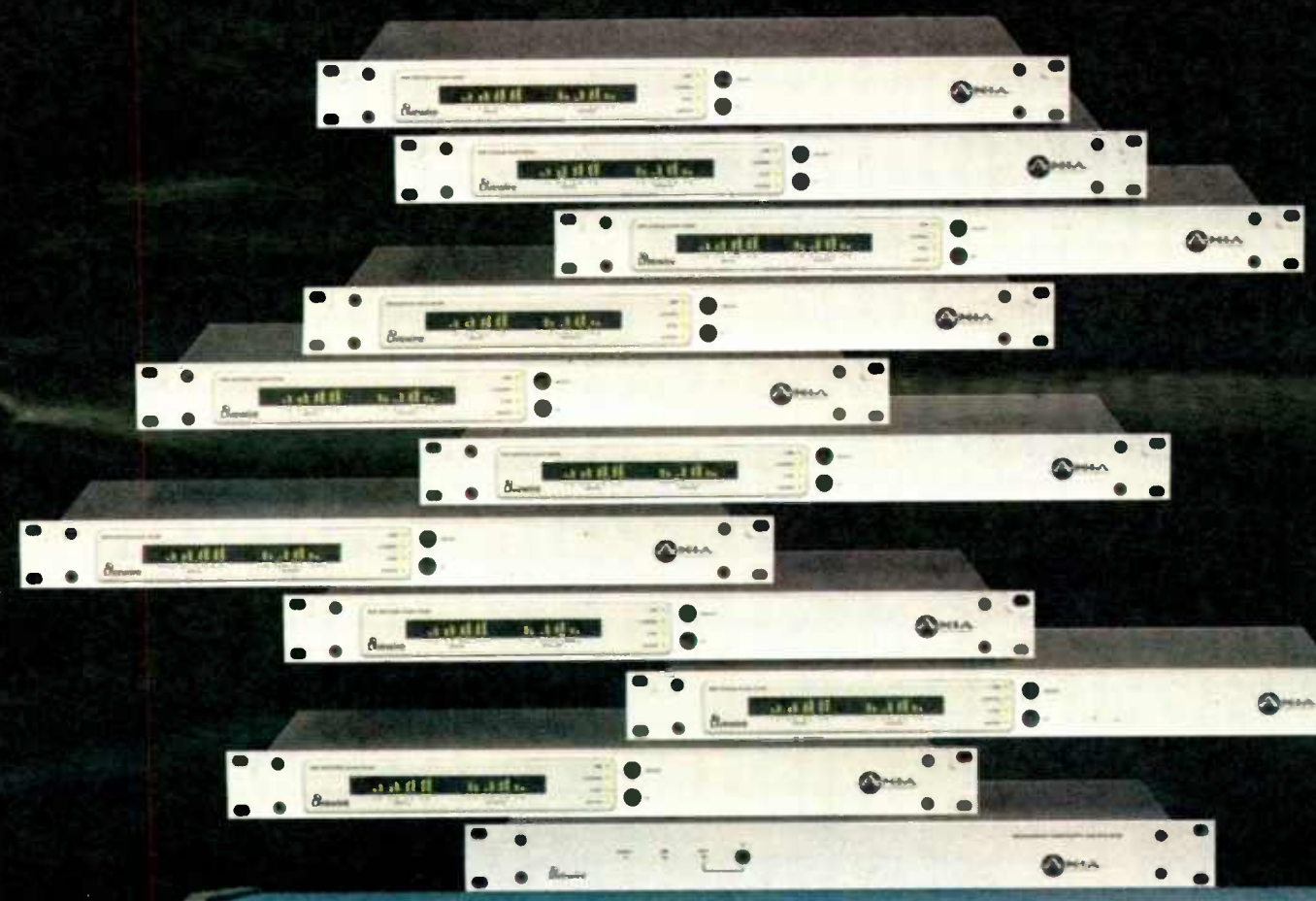

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Hashbusters

CONTINUED FROM PAGE 6

anyone had any ideas. I got some great responses, including referrals to the Radio World Engineering Extra story on an STL dropping out once a month that turned out to be a meter reader's device that was off frequency ("Sage and the Case of Liz the Meter Reader," Aug. 22).

This would have to be one obsessive-compulsive meter reader though, doing it every weekday.

Wednesday, after time spent on Google Earth, I picked a spot in the direction of the first heading and more in line with the second where I was sure to see both signals and get a better bearing on the first one that was taking the station down.

We set up in the rain and at 4:30 p.m. the station went down for just a few seconds but long enough to determine we could not pick up the signal. At that point Roger said I could just keep the spectrum analyzer and the antenna for a while.

FOLLOW THAT SIGNAL

I was feeling like telling the announcer it was alien communications and to wear aluminum foil on his head.

Instead I spent my afternoons waiting for the powerful interfering signal at various locations with a Yagi antenna, getting strange looks from a lot of people and waiting for the Department of Homeland Security to show up and question me. The bearings I got never seemed to line up to a single point, and sometimes after the signal went away I would see it answer from a different direction.

I talked to all the businesses in the area. I had a few suspects, like an LP gas company with a huge antenna that could be sending out an end-of-business-day inventory check with tanks reporting back their volume and pressure. Or the multi-building electronic-controls engineering company with transformers in the megawatt range and a lead-lined laboratory. But nothing panned out.

Then it dawned on me that the signal strength was proportional to the distance I was from nearby Carolina Beach Road. I decided to move farther up the road, so I set up in a stadium parking lot along the road several blocks up and pointed the Yagi parallel with the road in the opposite direction of the tower.

At 4:35 p.m. I saw the signal slowly start to rise and it was definitely coming from the direction I was pointing the antenna. After a while it maxed out at about –50 dB and then quickly faded. I stood there thinking of things in that direction: a TV station, Coast Guard station, a pager company, cell towers and another FM.

After a little while I noticed the station dropped out. It hadn't when I saw the signal. I swung the antenna around but saw no signal.

That would mean three separate transmitters along the road: the one I had just seen, which would activate the one closer to the tower, which in turn would activate the one on the other side of the tower. Maybe some type of new traffic light/count reporting system? That just didn't make any sense.

I was getting frustrated and I had a vacation booked for the next week. How could I leave when the station is dropping off the air?

After sleeping on it, I started to think about it being mobile. Not one transmitter answering another, but one that is moving down the road. To test the theory I got Roger to ride shotgun holding the Yagi on a stick out the window (see Fig. 3).

We went back to the stadium and waited. When the signal slowly rose up I cut out into traffic. Roger could tell if it was in front or behind me, so I jockeyed around as best I could in traffic and got it somewhere in front of me. We followed the signal for about a mile. When we were close to the tower the station dropped off the air.

Fig. 3: Roger ready with the Yagi.

Fig. 4: Here 'the offender' is seen stopped at the light in front of the Mustang (second vehicle from bottom).

I then realized the length of time the station was off the air depended on if it made or missed a nearby stoplight.

I photographed the vehicles at the light and we narrowed it down to four before the signal just shut off. Nothing suspicious about any of them — no antennas — but at least I now knew it was a vehicle.

The next day, I had members of our promotions department set up at the intersection with video and digital cameras in case I couldn't get into traffic when I picked up the signal. We picked up the signal about three quarters of a mile up the road where we were parked and I was able to merge into traffic.

The interfering signal cut off before it reached the area where it takes down the station, but not before we identified a vehicle from the previous photo about six or seven cars in front of us. I called ahead and they got pictures of the Maroon Ford F150 with a topper, no antenna and a "Be an Organ Donor" bumper sticker (see Fig. 4).

CONFRONTING THE CULPRIT

We continued the pursuit, losing sight of him once, but managed to guess the right turns and eventually caught up to him. We followed him all the way to his house in the next county. I confronted him in his driveway, told him who I was and asked if he had some type of transmitter in his truck.

With Roger as a witness he admitted that he had a cell phone jammer in the truck. He said he was tired of people talking on their cell phones while driving and that he had almost been run off the road, so when he drives through town he turns it on, taking out everything in a five-block radius.

I was shocked. The whole time I thought it was some type of malfunctioning equipment. I never thought someone would be doing it on purpose.

I told him, "If you don't like people talking on their cell phone while driving, you write your congressman. You don't operate an illegal jammer."

I laid into him explaining how I had spent the last three weeks tracking him down and he said he wouldn't interfere with the station ever again; but I felt further action needed to be taken. I wouldn't be surprised if he continues to use it in other parts of town.

From the address, I looked up his tax records on the Internet, got his information and contacted the police department. They ran his plate to make sure it was his address and checked with the district attorney about charges.

The DA advised it would have to go through the FCC, so I passed the information on to the commission. He was not only causing cell phone calls to drop, such as emergency 911 calls, but all kinds of communications. It could even screw up pacemakers. Besides, everyone around him with a cell phone is made even more dangerous because they are all trying to redial their number.

I did a Google search on cell phone jammers and found several sites. These devices can only be possessed in the United States by the military, but are sold on the Internet from Israel, Asia and the U.K. They offer models from high-power, like the one he had, to pocket versions so you can disconnect the call of that annoying person at the next table in a restaurant.

I was shocked. The whole time I thought it was some type of malfunctioning equipment. I never thought someone would be doing it on purpose.

One site, *www.methodshop.com*, said, "Even though jammers are illegal, it will be pretty difficult for the FCC to catch you. Triangulating the exact position of someone with a jammer will require some fancy hi-tech tracking gear and several personnel."

It goes on to state correctly that if somehow you are caught, the FCC's first offense penalty is up to an $11,000 fine or a year in prison.

I contacted the local head of engineering of a large cell phone company, as they were the intended target. He said he had no idea these things were out there and that it scared him to death how easy they are to get on the Internet. There are even models that only turn on when they detect a phone in use, so they are much more difficult to track. It really makes me wonder how many of these things are out there and how much of a growing problem this could be.

Although this story is not over, I guess the point is to make engineers aware that these things are out there and that there are no practical controls in place to stop them from being acquired. Something to think about the next time you drop a call or an STL. And this guy would have gotten away with it too if it weren't for us meddling kids.

Tim Nelson is chief engineer, Cumulus, Wilmington, N.C.

Did you solve a radio engineering mystery? Tell us about it. Write to mlrwee@verizon.net. ■

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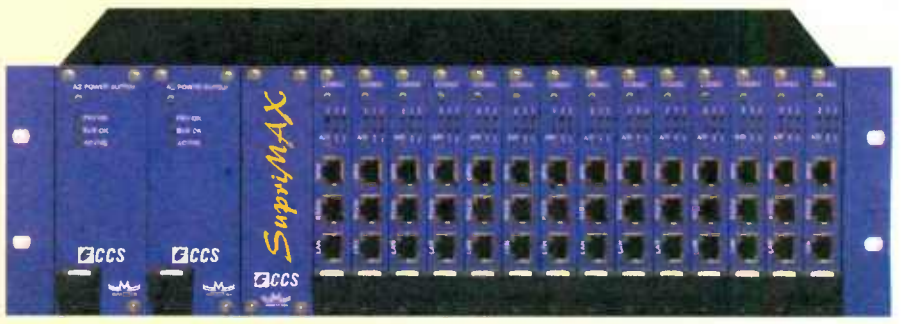

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Translators

CONTINUED FROM PAGE 4

interfering with existing contours? Can we effectively cover the community with such a signal? So the applications were filed and we waited.

In each case, three frequencies were applied for because there was always a chance that we would lose a potential frequency to an interference issue. This was wise. In almost every case, we were granted only one channel for each location in the end, the other two soon appearing on an "MX" list issued by the FCC.

When two or more stations apply for the same frequency in a region it is listed as "MX", or "Mutually Exclusive," which essentially means that the granting of the application would create an interference violation. An MX'd application would also come about if the translator shows potential to interfere with existing licensed services, such as a station on a next-adjacent channel. In the battle for frequencies, if an NCE station applies for a frequency applied for by a commercial station, or one which would create interference to an existing commercial station on frequency or next-adjacent, the NCE will lose the application. In a case where one useable non-interfering channel exists, with no overlaps created by others during the filing window, this is referred to as a "singleton."

Singletons are good news, but never a guarantee. A singleton will mean that you are likely to be granted a construction permit and license to cover from the commission, but if a local listener to a distant station on that frequency begins to squawk that you have interfered with their ability to hear that distant station, there is the potential for trouble.

WFCR found that most of our requested channels were MX'd, but because we applied for more than one in each location we were able to get one usable channel in all of them, albeit conditional to height and power. Within weeks the first of the construction permits had arrived. Once you have your construction permit it may be

Clarke Boynton of Cardinal RF Systems aligns the North Adams receive Yagi.

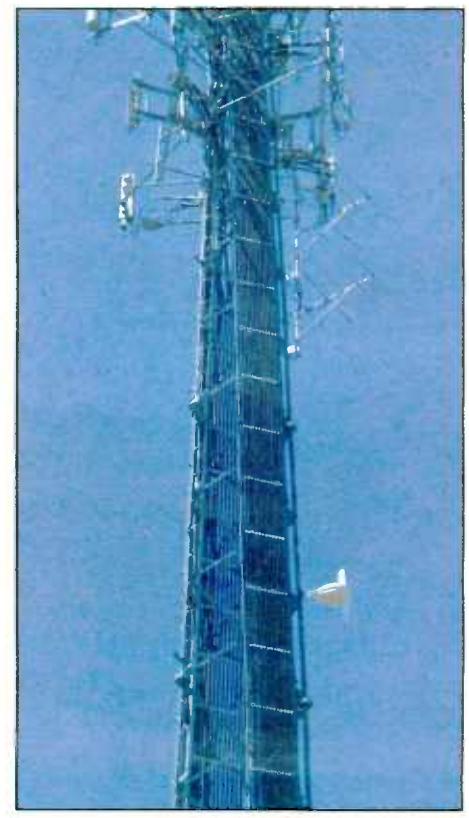
A cost not originally envisioned for this installation was the crane necessary to install a pole of the landlord's structural engineer's specifications. The presence of 'contingency funding' in the budget kept this from becoming a problem.

time to consult with another engineer, this time of the "structural" variety.

CALLING ON THE PROS

Due to recent changes in tower rules, tower companies have become very sensitive to the structural integrity of their properties. It was almost always the case for us that the tower company would require a structural analysis be performed on any proposed site. This is on the customer's dime and could run around $1,000 to $2,500.

We were required at the time of request to provide specifics to the owner's engineering



Stacking Yagis added enough gain to the received signal to stabilize reception throughout the year. The single-bay transmit antenna sits below.

departments of what antennas and feedline we were using. The tower company usually provides available heights they are willing to rent. We needed to be sure their proposed heights were workable. In one case I was given receive and transmit antenna heights at exactly the same location! This would require one heck of a lot of filtering, and we were able to negotiate another height for our receive antenna.

The lesson is that often the people making these decisions might not be familiar with broadcast-specific issues. A visit to view the tower is important as well. The tower company's own documentation may be outdated and inaccurate.

Where it is obvious that your antennas will be replacing existing structures, or not adding to the appreciable weight and wind-loading, you might qualify for a "structural letter" as opposed to a full-blown structural report, which will save you some money. It essentially demonstrates that the owners have reviewed the installation and have agreed to its impact.

A professional engineer with a state stamp — often it must be from the state in which the tower is located — may be a requirement of both the tower company and the town or city's building inspector. Rates vary somewhat but locating one who has familiarity with the tower you are proposing can save you money. It is far easier for them to modify existing CAD files that they have in the office, and have instant access to the details of what's already populating the tower.

Some PEs will be happy to assist other PEs with the transfer of this material, but

SEE TRANSLATORS, PAGE 26

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Translators

CONTINUED FROM PAGE 24

there will be a cost associated with this. If no one is able to determine if existing studies are obtainable, the structural engineer will have to recreate them, which will entail greater cost and time. A PE will provide documentation which can then be presented to a town planning board or building inspector, as well as for the tower company. Inaccuracies in existing documentation will be accounted for and corrected.

DOWN TO THE ELEMENTS

The choice of antenna for a particular site might well be the most important decision.

Think of where the antenna is to be located. If you have icing conditions common in the winter, like here in the Northeast, radomes or heaters are important. This will erase some makes and models of antenna from your list, as they may not be available with radomes (especially at translator power levels).

An antenna installation on a public building such as an apartment or offices will involve radio frequency radiation studies to be made to determine human exposure if your effective radiated power is in excess of 100 watts. In such cases the broadcaster can be forced into a multi-bay antenna selection to reduce downward radiation in areas accessible to the public or workers. Tower space and rental rates also may "steer" you; multi-bay antenna space may be too expensive or the tower may lack the room required.

Determine early which antenna you will be using, because as you begin to figure in that antenna's gain factor coupled with antenna feed line loss, you can plan what your transmitter hardware will look like.

BIG WORLD, SMALL TXS

The choice of transmitter will be dependent on what transmitter power is allowable at that location and height.

For translators this will vary between 10 and 250 watts. Smaller translators are available as complete packages with an incorporated FM receiver. In some instances we chose to utilize an FM exciter fed from a high-quality FM receiver.

The Inovonics 631 is a popular FM receiver for translator use, and features logic to drive a mute relay activated either by a loss of received carrier or audio silence (satisfying that FCC requirement regarding loss of program). It also provides a composite output that drives an exciter directly; and a selectable bandwidth filter, which is helpful in reducing adjacent-channel interference. It is one of many, and not the only such receiver designed for this specialty.

At higher ERP levels the transmitter choices start to look like full-power FM stations. Depending on your antenna choice, you might end up with as much as 600 watts TPO for 250 watts ERP. As the transmitter output power is increased, cabinet size, ventilation and commercial power requirements become paramount. Transmitters in the 500 watt range will probably require single-phase 220 VAC. They also will generate a lot of heat, so researching the transmitter's airflow requirements is required for any cabinet installation.

A simple, clean translator consisting of a BE exciter in a Kintronics cabinet.

And be sure not to undersize the cabinet if your installation isn't in a building. If you are located in aggressive climates such as near the ocean, air conditioning might be needed to reduce the amount of moist or salt air entering into your transmitter's chassis. If your cabinet utilizes fans for airflow, be sure that air entering into the cabinet is filtered. Furnace filters or air conditioner filters can be useful in screening air. Be sure to inspect any screens and filters on a regular basis during the pollen season.

THE GARAGE ISN'T BIG ENOUGH

As we were planning our translator installations, and seeing that many were clustered regionally, Brian Szewczyk from Harris suggested the hardware be shipped to a central location where it could be stored until the construction dates arrived. This saved me from having to drive a great distance back to the main studios if I had forgotten something, and also made it convenient for meeting with the riggers, who usually had more capacity to transport antennas and feed lines than I did with my vehicle.

Be sure to budget for rental costs for storage. You might be there for months, or more.

NO, WE'RE NOT INSTALLING A 'MOONRAKER' HERE

Building permits seem to be one of those things that vary widely from town to town.

Some towns are relaxed about their codes as long as the construction isn't major, such as simply adding antennas to a pre-existing tower and using a shelter already on site. Others have stringent requirements, usually involving the hiring of a professional engineer to create detailed drawings and oversee construction, as well as review and sign off upon completion. There are fees associated with this so prepare for them in your budget.

Be sure to contact the town's building inspector well in advance to find out specifically what they are looking for. Ask questions. Many towns do not include language on their forms relevant to broadcasting.

We once spent excess time trying to convince a planning board that we weren't installing cellular, citizen's band or ham equipment. Then we had to convince them to allow us as a "carrier" onto a tower in which they had previously imposed limitations. That process cost us almost a year.

A decade ago, during the big push for cellular towers, some town planning boards were simply overwhelmed by aggressive companies doing construction. There was a strong financial incentive to build it quick and move on to the next town.

As a result, one municipality we dealt with had a bitter taste about this and imposed a restriction on the amount of "carriers" (*any* RF generating device) allowed upon a tower — although in another part of the bylaws it insisted that towers be maximized in order to avoid construction of others.

A previous tenant already had exceeded that limitation, and this was poorly documented as well. Therefore it took our legal representation more than a year of negotiation to be allowed to apply for a special hearing with the planning board, followed by a reaction period for the community; not until then were we allowed to apply for the permit. More time lost.

'SPECIAL OPERATING CONDITIONS'

Once the construction permits were issued, we learned about special operating conditions the FCC imposes upon the construction, usually in the interest of negating interference with nearby airports or sensitive AM directional antennas systems.

In one case, our tower's proximity to a non-directional AM station created the need for us to perform a partial proof of performance of that AM station before we hung our equipment, and then again afterwards to demonstrate that our appurtenance did not effect the re-radiation characteristics (detuning) of that tower. Adding any antenna to a tower is considered, in the parlance of the commission, a structural change to said tower.

The special operating conditions found on our construction permit required a series of field strength measurements on six radials, eight points on each one, both before and after the addition. Again, we are discussing an increase in costs for construction, as this requires at least the rental of a meter or the hiring of a consultant to perform the measurements and create the documents for submission along with the license application.

In our case, I did the measurements myself (thanks to the good graces of a friend who loaned me a recently calibrated meter); these were submitted to our consultant for review and to create a proper presentation to the commission.

Requirements for proof of performance vary depending on the type of AM station. CFR Part 73.1692 states that a partial proof is required if the modified tower is within 0.8 km of an AM non-directional tower. Also, modifications of a tower structure within 3.2 km of a directional AM station will trigger

SEE TRANSLATORS, PAGE 28

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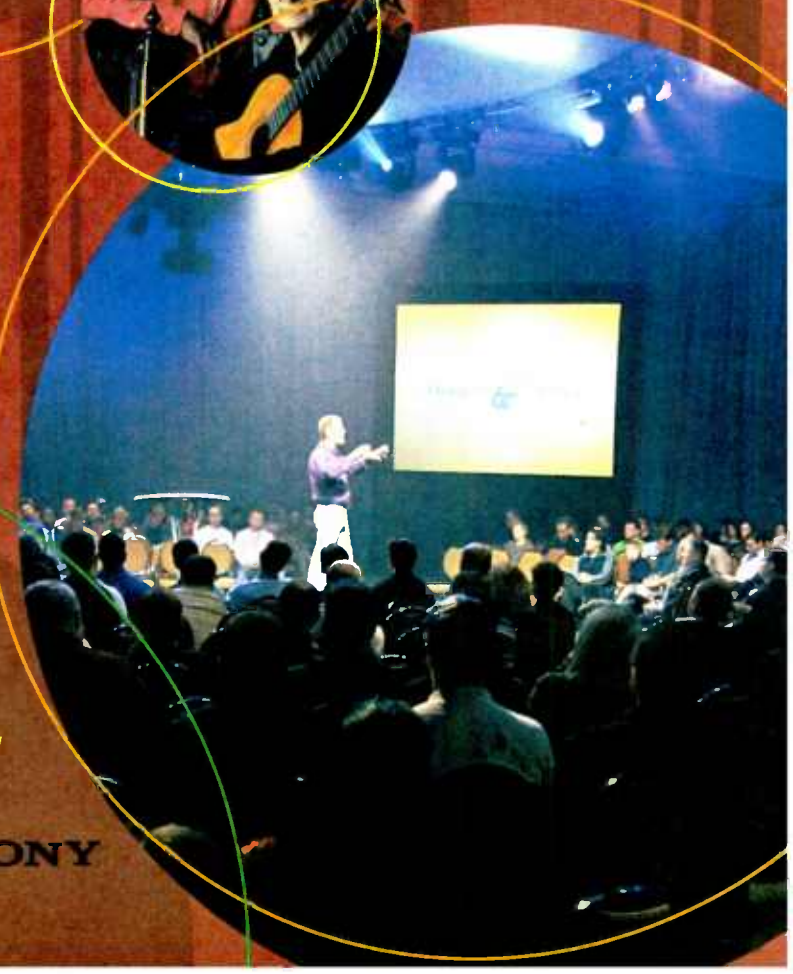
The person-to-person contact is invaluable. In just a few days, I am able to meet with many of the major ministry leaders from throughout the U.S. without having to travel to their home offices.

— Dick Jenkins, CEO EMF Broadcasting

I look forward to NRB each year as it is a fantastic opportunity to rub shoulders with people who are also involved in the ministry of media. It's a worthwhile investment of my time and energy to be educated by and to fellowship with the people who are leading the way in this arena of ministry.

— Mark Zschech, Hillsong Church



What makes going to NRB so worthwhile is interacting with other decision makers. My peers are there and I am always amazed how much I can mmediately get done to advance this radio ministry by attending NRB.

— Tim McDermott, President/General Manager, KSBJ

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by Cris Alexander

Field Notes at 3 A.M. Could Be Faulty

A Project Takes the Long Road to Completion After Incorrect Measurement Forms Basis for Antenna System

In our previous episode, I talked about learning from our experiences as radio engineers (Oct. 17). That is an ongoing process, one that sometimes doesn't come easy. While such lessons can be an aggravation, they often have great value and the potential for changing the way we do things in a big way.

Several years ago, our company purchased a 50 kW DA-2 in Birmingham, Ala. The transmitter site and antenna were in a sad state when we bought it, having been through several owners in the preceding years. Some of them did nothing but allow continued deterioration; the most recent had made some effort.

He hired a consulting engineer (who has long since retired) to get the antenna system back in shape, and he contracted for a new phasing and coupling system. This consulting engineer did his best with what he had available and within the limited budget to set things right, but the money evidently ran out long before things were fixed.

So I walked into a real challenge. It was hard to tell where things really stood with regard to antenna system, patterns and transmitter. We quickly decided to raze everything except the towers and start over, and that is exactly what we did.

We started with a new transmitter building right in the middle of the five-tower parallelogram array — the old building had been at the property edge. This new building location made for more optimal transmission line runs and lengths. It also allowed us to continue operating the existing mess (at reduced power under an STA) while we built out the new facility.

A new phasing and coupling system was designed, ordered and delivered to the site along with new transmission lines, sample lines, antenna monitor, transmitters, audio processing — everything. Not one piece of the original equipment complement was kept.

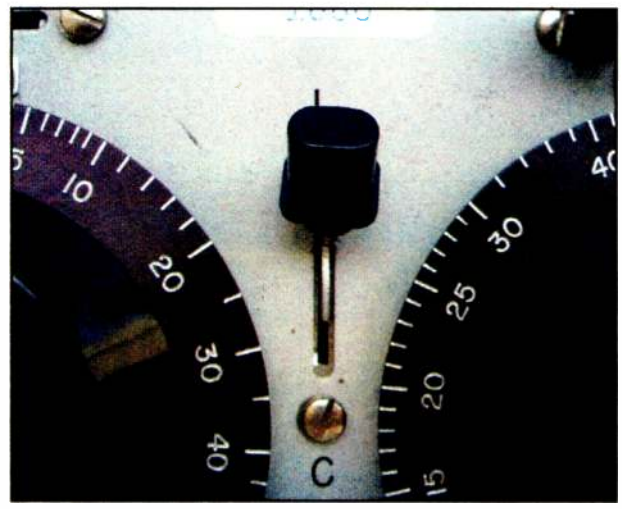

Fig. 1: An OIB is used to measure impedance under actual operating conditions.

Rather than reinventing the wheel, I opted to retain the previous owner's consulting engineer. This gentleman was experienced and he knew the two-pattern array well. I reasoned that with his knowledge of the array and the local geography, he would be better positioned to tune the patterns up than I.

So he and his helper spent the summer installing antenna tuning units, transmission and sample lines, phasor, transmitters and all the rest. By September, they were ready to start tuning.

THE RED NOTEBOOK

Let me rewind just a bit at this point.

I mentioned that a new phasing and coupling system was designed and ordered. I did that design myself and I based it on a set of measured driving point impedances provided by the consulting engineer. He had obtained these years before when tuning up the array for a previous owner.

He adjusted the pattern to the licensed values, inserted the operating impedance bridge (OIB) into each tower feed in turn, tuned out the insertion effect and read the impedance (see Figs. 1 and 2). He entered these values in a red notebook that contained all his notes from the project, going back several years.

When I started the design, I ran a couple of models on each pattern. First, I ran a set of conventional calculations using "chart values" of R and X for the radiator height, calculating mutual impedances, system losses and predicted driving point impedances (DPIs). Then I ran a method-of-moments model.

Not surprisingly, both the conventional calculations and the model DPIs were reasonably close to the measured night pattern values provided by the consultant from his notes.

But the daytime was a different story. The conventional calculations and the numeric model agreed with three of the four DPI values reasonably well, but one tower differed considerably; the sign of the reactance was opposite the

See LESSONS, page 30 ▶

Translators

CONTINUED FROM PAGE 26

this requirement. The commission will state specifically on the construction permit what specific parts of 73.1692 they require.

A translator constructed within proximity of an airport will trigger a special operating condition requiring the translator to be immediately reduced in power or shut down if it is found to be creating interference to aviation services.

Translators must adhere to the OET 65 rules regarding human exposure to RF.

One of our translators was on the roof of a utility building at a regional college. The transmitter's ERP at this site was in excess of 100 watts, employees required access to the roof for air conditioning work or roof repair and there was a smokestack adjacent to the building with cellular equipment attached, so we needed to determine the power density of our emissions along with those of the cellular equipment.

Utilizing data obtained from the college about the existing RF density, our consultant was able to calculate that at this site the installation did not result in power densities that are in excess of the permitted level for uncontrolled exposure in any area accessible to the general public.

All of this was packaged together for submission to the FCC along with our application for license to cover.

THE FUN PART

Although it might appear otherwise, I found actual construction to be the easiest part of the project.

We had the fortune of working with contractors with whom we were familiar. They knew to review my lists to be sure I ordered enough grounding kits, and made up the specific braces and mounts needed for the antennas.

It is important to be on-site and oversee your installation. At one site I had to make a quick decision regarding relocating an antenna once I found out that the tower company location for our receive antenna was a couple of feet from a full-power FM antenna. Our contractor was quick to bring this question to light, as opposed to just installing it.

It is vital to be aware of other services on the tower that might interfere with you or vice versa. Some paging services might be located on bands not far from the FM broadcast service. You'll discover this immediately as the front end of your receiver folds up with data bursts, or as you are on the receiving end of complaints from an irate owner of a two-way radio service. A bandpass filter for your transmitter, especially for higher-power transmitters, should be budgeted — along with a bandpass filter for your receiver, should you have commercial radio operators on the tower.

There is always a liability factor to be wary of when you look at someone else's equipment.

Then there is the local interference from the translator itself.

In one case I had a receive antenna placed less than 10 feet on a pole below an antenna radiating 250 watts. Even with three stages of filtering, there was an annoying hiss in the receiver whenever the transmitter was activated. I finally ended up replacing the directional receive antenna with a low-gain turnstile (fortunately my host signal is pretty robust at this location) and relocating it near a window inside of an equipment room at the penthouse near the translator.

The roof is steel; that attenuated the translator's own signal enough to make the receiver operational. This was after trying every available outside location and even considering moving the receiver itself to an adjacent building, which would have been costly. Simple is good.

Access to a spectrum analyzer served me in good standing to check the integrity of my own signal (looking for products resulting from intermod, for instance), or for troubleshooting interference from nearby RF sources. I also used the spectrum analyzer to field-tune a notch filter on-site.

Another good tool for the kit is some sort of wide-band monitor receiver with a signal strength meter. At one site, a piece of equipment in a neighboring building created a spur right on my 88.5 MHz receiver frequency. Using a Yaesu VX5 with a directional antenna helped me to locate that RFI source quickly. Ham radio to the rescue.

GOOD NEIGHBOR POLICY

These days, many entities may share a tower site: WiFi companies, two-way providers, cellular companies and other broadcast stations. The potential for spurious emissions is enormous. Your lease with a professional tower company will probably contain a clause requiring that you shut down should you even be suspected of interfering with a pre-existing tenant.

If your site is an apartment or professional building, you may be required to become involved in the troubleshooting of telephone systems, intercoms, house music systems, alarm systems or just about any other electronics devices that use devices subject to RF interference or long runs of wire and cable. But, as usual with such matters, proceed with caution.

There is always a liability factor to be wary of whenever you look at someone else's equipment. It's best if you can make recommendations but have someone associated with the other party do the actual hands-on work.

At one site, the translator I put on the air interfered with a neighboring radio station's consoles and telephones. We employed, at our expense, the station's contract engineer for the console work, which resulted in some general improvements to their facility in the long run, and I worked with their on-site engineer to filter most of the station's phone complement.

As of this summer, WFCR has expanded its signal into the Berkshire region of western Massachusetts, a historical event for the station. The five translators we constructed now provide convenient coverage in areas where potential listeners have been distracted for decades; from the northern part of the state near Vermont down to the Connecticut border. This area encompasses several arts communities as well as Tanglewood; for a classical music station, this is an obvious gain.

Tell RW-EE about your radio engineering project and the lessons you learned. E-mail rwee@imaspub.com.

Charles Dubé, CBRE, is chief engineer of WFCR(FM), Amherst, Mass. ■

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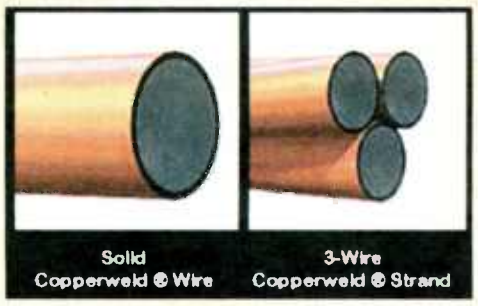

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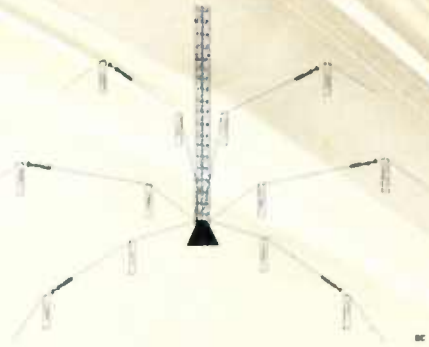

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Lessons

CONTINUED FROM PAGE 28

predicted value.

I challenged the consulting engineer on this, but he avidly maintained that his measured values were correct, stating, "They are right here in the red notebook."

One thing I have learned over the years is that field-measured values trump predicted values every time, so I did the design based on the consultant's measured values. Kintronic Laboratories built the new phasor and ATUs, loaded them on a truck and they soon arrived at the site.

The night pattern tuned right up. Kintronics had pre-tuned all the network legs to the design values, so there really wasn't much to do other than fine-tune the phasor controls to "nail" the parameters.

Monitor points were checked and found to be within the licensed values, so we knew that everything was right. All that was left for the night pattern was to adjust the ATU networks to match the transmission line impedances precisely. They were already close, so that didn't take long.

But then came the 50 kW day pattern. It would not work. The parameters were way off the mark. Tower 2 would not take any power at all. After messing around with things for several days and concluding that the phasing and coupling system design was faulty, the consultant gave up. I boarded a plane and headed east.

THE BRIDGE DOESN'T LIE

When I got there, the first thing I did was put the OIB at the Tower 2 ATU input. The R was very low, near zero, and there was a little inductive reactance.

I took a vacuum variable we had lying around, left over from the old phasing and coupling system, and temporarily shunted it across the ATU input. I adjusted it to the equal but opposite reactance I measured at that point with the OIB. As a result, I raised that near-zero input impedance to 20 ohms or so.

We brought the transmitter up and this time, I got some current in Tower 2. The parameters were still trashed, but we were getting power into that tower.

Next, I took the OIB out to the #2 ATU and inserted it in the tower feed. We brought the transmitter up and I read the R and X on the bridge. I can't remember what the R was, but the X ... it was the opposite sign of what the consultant's notes said — the same sign as the model had predicted.

Shutting the transmitter down, I did a quick redesign of the #2 daytime ATU network, flipping the sign of the reactance but otherwise using the consultant's measured numbers. We had plenty of parts on hand, so it was a simple matter of changing the output capacitor and readjusting the leg reactance to the new value (the input and shunt legs did not change).

We brought the transmitter up, and the parameters were all in the very near ballpark. Ten minutes of adjusting and the parameters were "nailed" on the antenna monitor.

TRUST THE THEORY AND YOUR EXPERIENCE

The consultant was amazed. He stood there shaking his head, saying, "But it was in the red notebook!"

I still have a lot of respect for that consultant, transposition of the reactance sign notwithstanding. You've been there and I have too. It's easy to make an incorrect notation.

In this case, he simply omitted the little minus sign in front of the reactance value. It probably occurred in the dead of night after hours of work.

We both learned something from that experience. He learned that he should have questioned why the reactance sign on one of the daytime towers was different than the other three when the radiator height and cross-section were the same. I learned the same lesson, but I also learned I could trust the model.

That was really something I should have already known from past experience. Several years before, as I was preparing to construct a brand-new 50 kW DA-2 in Denver, I made the investment in some method of moments modeling software and began experimenting with it.

When we got the towers up, I made a lot of impedance measurements and then further refined the model. It gave me a set of base parameters (currents and phases) that would produce the proper pattern. As the project progressed, I spent a lot of time calibrating the sample system, carefully matching the electrical lengths of the sample lines and checking for consistent loss.

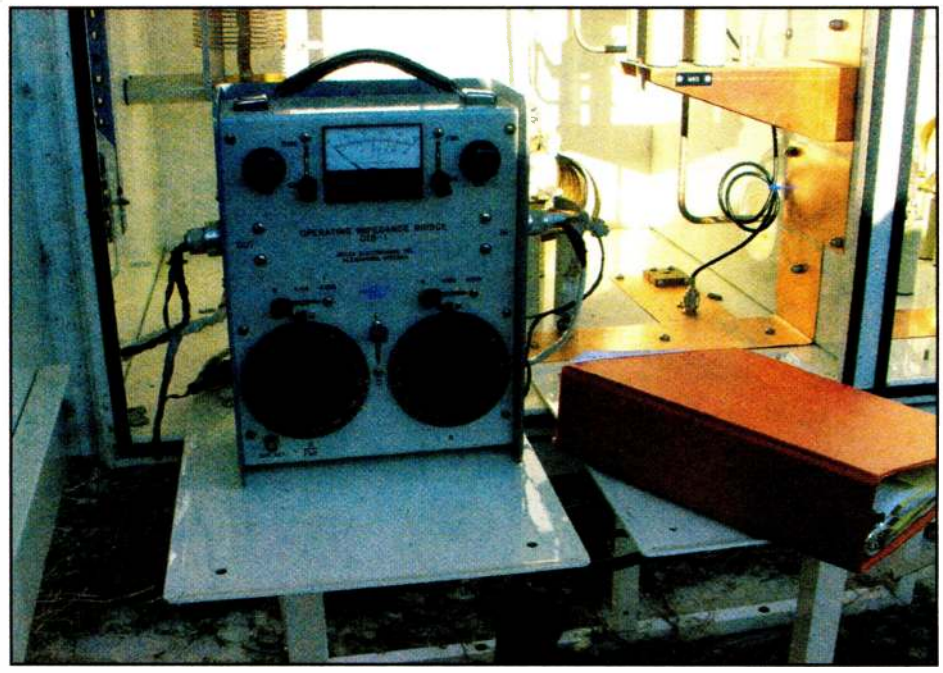

Fig. 2: Driving point impedances were dutifully but inaccurately recorded in 'The Red Notebook.'

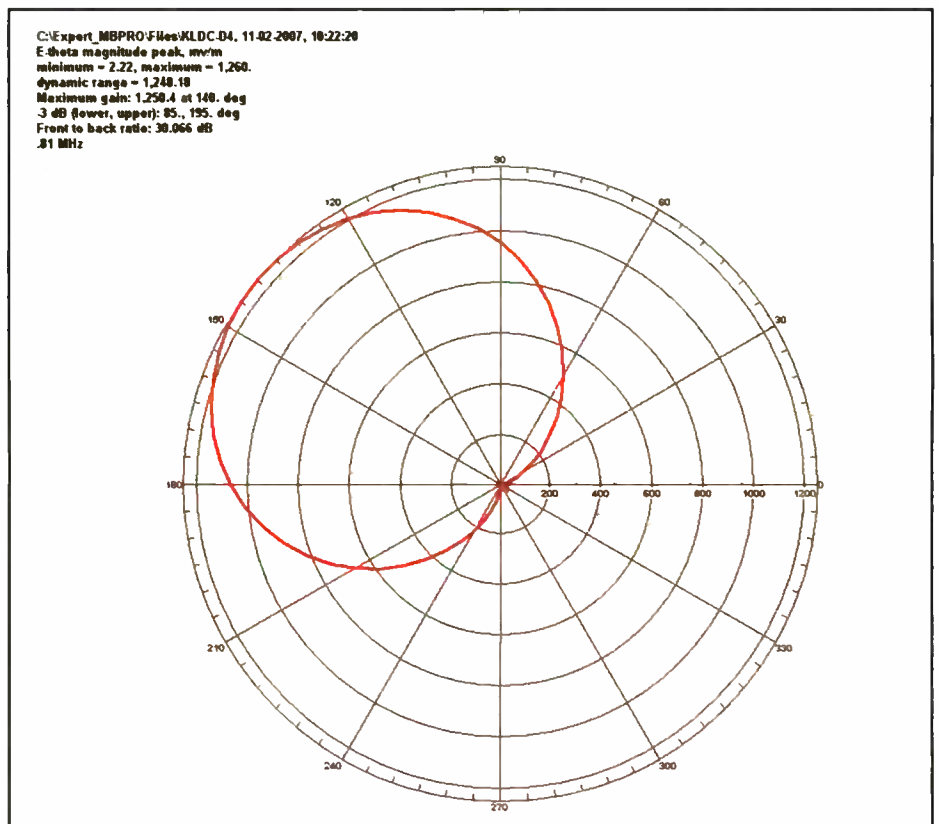

Fig. 3: Pattern plot output from Broadcast Mininec Pro antenna modeling program.

Since that initial experience, I have used numeric modeling on every eligible array I have built or rehabilitated to good effect. I am a believer (see Figs. 3 and 4).

Several years ago, in response to an FCC Notice of Inquiry, a proposal was made to allow the use of method of moments modeling for AM directional antenna performance verification. That proposal sat on the back burner for some time but was frontburnered earlier this year.

A coalition of radio groups and consulting engineers got behind it, updated it based on the additional experiences of the coalition members and got it on the FCC's radar. The proposal (MM Docket No. 93-177) is now in process. We hope to see it enacted into law at some point soon.

I support this proposal for a number of reasons. The first is that it works. I've seen this myself on several occasions, and many other engineers I know and trust have used modeling extensively with good results.

Another is that it is getting harder and harder to get unobstructed field intensity measurements of AM signals. As I plot measurements these days, there is often so much scatter that graphical analysis is nearly impossible, and numerical analysis results in an inverse-distance line that sometimes doesn't well relate to the scattering of points on the graph.

A third reason, and I concede that this is purely selfish, is that I have a 10 kW three-tower DA build/tune-up on the calendar for next fall. Matching a model as a means of performance verification beats the heck out of slogging through muddy Colorado cornfields.

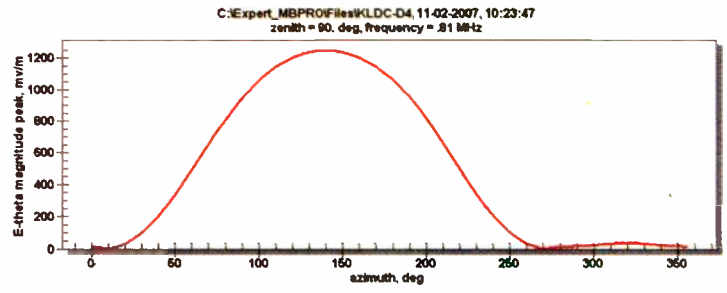

Fig. 4: XY Version of the Model Plot

ENGINEER TALENT REQUIRED

As a young man entering the broadcast engineering trade, I had some great teachers, men who saw the value in bringing up the next generation of broadcast engineers through generational teaching, a passing of the baton, so to speak. They taught and mentored me because someone had taught and mentored them. It was the way things were done in those days.

Under the tutelage of these seasoned and experienced engineers, I learned there was a great gulf between what I learned in school and the "real world." I found that the theory was right, but situational exigencies required a different approach, often a short cut from the ideal/theoretical.

I'll never forget one such lesson. Pat Gilbreath was then the chief engineer of KFDA(TV), Channel 10, in my hometown of Amarillo, Texas. As a newly hired engineer, a row of malfunctioning video monitors awaited me.

As I began troubleshooting the first one, I quickly found the symptom: no vertical lock; the picture would continuously "roll." I started poking around the sync separator circuit with a scope probe and was closing in on the suspect area when Pat walked in. He looked at the schematic, looked at the monitor, grabbed a new 47 uF electrolytic cap out of the bin and touched the leads across a cap of the same value in the sync separator circuit. Instant vertical lock.

No doubt I would have found the problem eventually, but Pat showed me how to

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Lessons

CONTINUED FROM PAGE 30

look at the schematic, make a guess as to the most likely source of the problem and then verify that without so much as plugging in a soldering iron. Those monitors were fixed in no time.

As I entered the world of AM antenna systems, another mentor, Charlie Gallagher, P.E., taught me well. Under his watchful eye, I built from the ground up a five-tower, two-pattern 10 kW array, tuned it up and proofed it.

Charlie never set foot on that site. He did it all with me by telephone; we didn't have e-mail in those days and fax machines were scarce, an "emerging technology." In the process, I came away with a wealth of practical knowledge and skills I could have obtained no other way.

Over the years of my career, I've had a number of other teachers. Some stayed by my side for years, others came and went quickly. I learned to glean all I could from anyone I could as they passed through. I still do that any time if the opportunity presents itself.

It also has been my honor through the years to invest myself in the lives of a number of other up-and-comers, passing along the things I learned from my teachers and through experience in much the same way I was taught. What a thrill it has been to watch those individuals "get it" and go on to great things themselves.

THE ROMANCE OF RADIO

When I entered the trade, radio engineering had quite a draw. Young amateur radio operators in particular were drawn to it like moths to a flame.

They were fascinated by the tall towers, the big power, the glowing PA tubes and singing coils. They also were romanced by the idea of experimenting and building their own equipment, as broadcast engineers often had to do in those days. There was also the "show biz" attraction, but that was secondary.

Most of those facets of radio engineering are gone today, even as they are largely gone from amateur radio. We are now mostly "appliance operators" in both ham radio and broadcasting. We don't, for the most part, build our own stuff these days. We assemble a collection of "black boxes."

For the most part, we don't even field repair equipment much anymore. It's too complex and requires specialized tools and test equipment not practical and/or affordable at the station level. Even manufacturers are likely to "shotgun" returned equipment at the board level rather than trying to find a bad component in a sea of LSI and tiny SMT parts.

But all that notwithstanding, there is still a need — some might argue it is greater than ever — for skilled, properly trained broadcast engineers.

So, where is the next generation of engineers coming from? Are technical schools and colleges, even the military, funneling a stream of enthusiastic broadcast engineer "wanna-bes" to us? Hardly. I have to really work at finding young people with any interest these days. They are much more attracted to IT-related jobs.

The young folks we have hired in recent years almost universally came to us with good IT skills but little basic electronics and no RF knowledge. We have had to provide education and training in those areas ourselves.

One of my priorities in the coming years is going to be finding ways to attract young people to the radio engineering field. If those of us who are now the "senior generation" of engineers don't take some action now, it won't be that long before the ranks are very thin indeed.

Cris Alexander is director of engineering, Crawford Broadcasting Co., Denver. ■

Battle for the Band: AM IBOC Under Siege

Nighttime Hash Complaints Slow Deployment & Operation of HD on AM Band, Raise Doubts

The interference fallout of full-time AM HD operations has been scattered and largely anecdotal. According to reports in RW, only one formal complaint has been filed as of this writing. By the time you read this, there likely will be others.

The AM HD rollout has attracted only about 225 licensed stations, mainly the wide-area coverage powerhouses and stations that also bought in early to the promise of 15 kHz stereo. About 175 are operational daytime while less than 70 are thought to be operating at night. That's less than 2 percent of the total inventory of U.S. AM stations.

Citadel/ABC has kept its AM HD flamethrowers like WABC, WJR and WBAP analog only at night while Cox is still choosing to keep all its AM stations' IBOC exciters turned off full-time. Clear Channel and CBS still have the majority of their AM stations unequipped for HD.

Many think the handwriting is on the wall and AM HD is in deep trouble.

SOMETHING'S FISHY

This rollout has been like watching a small group of particularly aggressive salmon swimming in a crowded and polluted river upstream against tall odds and rocky rapids. The AM band with all of its overlapping adjacent-channel allocations and skywave issues was not going to allow an easy transition to digital.

Squeezing digital modulation into an AM channel to give the service 15 kHz stereo would prove to be incredibly challenging. In a sense, the IBOC engineers who invented AM IBOC were virtually "forced" to make it work. Serious compromises had to be made and secondary coverage had to be sacrificed. Ibiquity no doubt underestimated the importance of most stations wanting to maintain their existing analog service areas.

Quite a few small-market AM owners are convinced that NAB and Ibiquity conspired with the FCC to hasten their demise with the adoption of AM HD. They reason that only the big boys will be able to afford acquiring the licensing, equipment and antenna system improvements — not to mention their willingness to lose big chunks of important secondary coverage.

If implementing IBOC for radio broadcasting really was a conspiracy, the prime movers didn't plan it very well. The industry clearly wanted a new digital transmission solution to keep both AM and FM competitive with other media. The positive enhancements of AM HD are available to any station. Many of its negatives unfortunately affect all stations on the band, whether they adopt it or not.

The introduction of a new technology and standard will always inflict pain and suffering of various forms during the transition. I see this as coincidental and the result of unintended consequences more than a veiled attempt to put small stations out of business. The truth is many small AMs were teetering on failure long before AM IBOC arrived on the scene.

As RW commented in a recent editorial, even a number of major-market stations that have deployed AM HD are feeling the pinch of reduced coverage at night. Those with strong adjacent-channel neighbors have had their effective nighttime interference-free (NIF) contour values increase by double or even triple.

Listeners who could previously hear the station without interference out to the 5 mV/m contour, for example, would now experience much more interference at that distance and have to move closer to the 10 or even 15 mV/m contour before the additional interference caused by IBOC noise becomes unnoticeable.

WYSL VS. WBZ

Bob Savage, owner and operator of WYSL(AM) 1040 near Rochester, N.Y., filed a formal complaint in late October with the commission and WBZ(AM) 1030 regarding lost protected nighttime, critical hours and even daytime service in the Rochester suburbs.

According to Savage, the strong IBOC hash from WBZ on 1040 during most nights hammers a good bit of WYSL's coverage area inside its normally predicted NIF contour of 13.7 mV/m. And he's made a lot of off-air digital recordings to prove it.

The real WYSL NIF contour is now 28.2 mV/m with WBZ running AM HD full time. That figure is supplied by Barry McLarnon, a well-known broadcast consultant and self-proclaimed AM IBOC naysayer based in Toronto. McLarnon has been beating a drum that too many in this industry are underestimating the real effects of AM IBOC interference to first-adjacent channel stations.

One of the nasty realities many overlook in the AM IBOC controversy is the presence of substantial daytime (and especially critical hours) skywave that drops in on top of first-adjacent stations from high-powered neighbors. It is painfully obvious in the crowded north central and northeast sections of the country and in the upper half of the AM band.

In a Radio World guest commentary, McLarnon lays out the basis of how and why AM IBOC digital sideband signals contribute significantly more interference to their first-adjacent neighbors than simple compliance with the NRSC mask would suggest ("McLarnon: Enough Is Enough," Dec. 5). If you keep an open mind and carefully evaluate the number-crunching, he makes a rather compelling case. McLarnon is helping Savage pursue and defend his FCC complaint.

Bob Savage is so upset about the entire IBOC proceeding that he and a few friends have set up a Web site called *www.stopiboc.com*. Watt Hairston, chief engineer for WSM(AM) in Nashville, and Jerry Arnold, director of engineering for Midwest Communications in Terre Haute, Ind., have joined Savage in creating what they call an "Anti-IBOC Alliance." The site invites sympathizers to sign up and become members.

So far, this battle looks like a David-and-Goliath encounter, but the real contest we all saw coming is just beginning to heat up. The outcome is anything but certain with the AM HD rollout now effectively slowed to a crawl by issues that will not be easily resolved with any quick fix.

There are a number of ways this impasse could end sooner rather than later.

As more stations go on at night and more interference complaints are received, the FCC could be forced to agree with McLarnon and decide the interference issues are serious enough to warrant rescinding nighttime HD authority. Rendering AM HD a permanent daytime-only enhancement could be its undoing. The pressure could come from affected U.S. stations but also from Canada or Mexico.

Either country could choose to challenge the FCC to enforce the spirit and letter of the international agreements struck more than 65 years ago that protect allocated AM station coverage contours beyond the borders.

But with many Canadian AM stations going dark by choice over the past 20 years, the CRTC (the Canadian FCC) has signaled that AM is not a major concern or priority. It is possible, however, that it may be waiting for enough U.S. AM IBOC stations to fire up at night before pursing a formal complaint that will need the backing of substantial evidence.

A less likely scenario would have NAB and major group owners pressure Ibiquity to forge a modified digital modulation scheme that produces less adjacent-channel interference. That would certainly seem to serve the long-term interests of AM stakeholders better.

Ibiquity would not be happy about resurrecting an R&D effort to find a better AM IBOC solution. Quite a few respected engineers in this industry have suggested that DRM offers important improvements over AM HD.

There just might be a technology breakthrough that could allow an even better method to encode higher-quality digital modulation with less destructive interference. We'll never know unless a new round of research and testing gets financial backing and proceeds. Time is not on our side on this one.

The majority of major broadcast companies who also are Ibiquity investors have essentially forfeited their interest in protecting secondary coverage in exchange for 15 kHz digital stereo. Plus, the AM band may have already declined enough in overall importance that none of the major players have the appetite to pursue such a fight.

WHERE TO FROM HERE?

What's likely to happen going forward?

The actions of Citadel and Cox give us a clue for the short term. Rather than risk causing increased interference to their own analog reception on some receiver models

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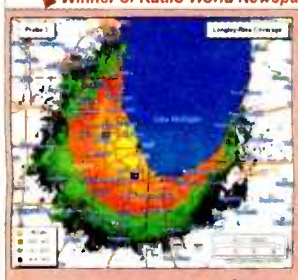

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Guy

CONTINUED FROM PAGE 35

and tolerating reduced nighttime coverage from other stations (often co-owned), other owners will selectively turn HD transmissions off.

Stations thinking about making the considerable investment to add HD will not likely do so unless the doubts about AM HD are somehow sufficiently resolved. We don't see that happening or a growth spurt in AM HD occurring anytime soon.

The pioneering AM HD stations like WOR and WBZ and others already operating who have decided HD helps more than hurts will leave it on — until and unless they receive enough legitimate interference complaints that force them to reduce IBOC power on one or both sidebands. If that happens to enough key stations, AM HD may not survive, even as a daytime-only enhancement.

On the other hand, FM HD delivers many more benefits without the interference penalties, so the HD rollout should continue to grow. Especially if Ibiquity makes it easier for car companies to include stock OEM HD radios in new models, and the FCC allows the anticipated 10 dB increase in FM HD digital power.

RADIO DARWINISM

The AM HD stations that can maintain full-time full-power HD operations and fend off interference complaints will establish permanent footholds at their dial positions. There's little chance the FCC would rescind HD authority for them. In many cases, rim-shooters affected by those stations that can no longer effectively cover their intended but unprotected service areas may have to throw in the towel.

With or without IBOC, as more of AM radio's audience shifts to other media choices, the band will continue to deteriorate and more of the marginal stations will go dark. Over time, attrition could whittle down the AM inventory to a less cluttered bandscape, allowing stations with good full-time coverage to eventually reconsider the advantages of AM IBOC and try deploying it.

The FM HD deployment will eventually put AM HD-capable radios into the hands of millions. At that point, converting to HD on AM will have an immediate benefit for most stations. But if the band doesn't remain viable long enough to get there, it may expire out of lack of interest and internal squabbling.

FOOD FOR THOUGHT

In previous columns, I've suggested the easiest way out of this conundrum is to dispense with the AM hybrid mode and postpone AM IBOC until HD receiver penetration hits critical mass for FM HD.

That would appear to be at least 15 years down the road, so it should be easier for the AM stations still remaining to switch off analog forever at the same time and commence transmitting the full digital mode.

I've also talked about ways the FCC could encourage the process of cleaning up the AM band. Those ideas include giving existing AMs the choice of trading in their AM channel for an LPFM assignment; granting tax certificates for retiring an AM license; allowing stronger stations to easily buy off weaker ones; and the imposition of a freeze on new AM station applications and elimination of an allocation once it went dark.

The goal would be to allow the band to become cleansed and healed so at least the stronger members might survive. I got hammered by various laissez-faire broadcasters for even suggesting such "heresy."

Don't forget that Mother Nature has more brutal methods to make this happen. Be it famine, flood or just the natural life and death cycle, survival of the fittest is a powerful imperative.

The truth is that our AM band is an overcrowded noisy neighborhood with many residents encroaching over bordering property lines. Hindsight tells us the old zoning laws have not been adequate or appropriate. IBOC is just making a bigger mess out of an already marginal situation.

The medium-wave spectrum AM uses is a perpetually available resource. There are more than 500 million radios that can receive AM signals out there in the hands of U.S. consumers. Unless some external event permanently alters the earth's magnetic field and atmosphere, the ability to propagate MW signals for the purpose of serving mankind is not going away.

Like cleaning up polluted rivers and clearing forest underbrush, we need to manage this resource smarter than the record of recent history has exposed.

Guy Wire is the pseudonym of a veteran broadcast engineer. ■

Buzz

CONTINUED FROM PAGE 38

Visibility into this hidden community provides a means for broadcasters to piggyback on which new songs are relevant to their audiences. McBride observes the irony of using stolen music as a source of marketing data.

Downloading is just another form of broadcasting. But unlike terrestrial radio, downloading is controlled by individuals who vote with their feet (or their mouse, as the case may be).

Whereas radio could make a song popular in the 1950s, it is now following the dominance of this alternative form of broadcasting. Perhaps ironically, rather than creating buzz, terrestrial radio now follows the smell of buzz. We can cry about the loss of radio's status, but we also can take pride in our ability to adapt to new realities rather than living in a dream world.

HD Radio is another example of word-of-mouth marketing. Unfortunately, there is no evidence that it has created any word-of-mouth buzz. There are two possible explanations this. Either the message or package has been poorly constructed such that it does not appeal to one of the seven motivations for spreading the word. Or, as some have speculated, it simply does not appeal to the market.

If someone hears about HD Radio and thinks, "I couldn't care less," that person is unlikely to mention it to anyone. In either case, the final destiny of HD Radio has little to do with technology.

In two previous Last Word articles ("The Tall Tale of the Long Tail," June 13, and "The Long Tail Wags Broadcasters," Aug. 22) I focused on the importance of the long tail, which emphasized how groups of individuals can find obscure songs they want to hear. The hidden question is, how do such groups find out about the existence of a particular song?

If you are 30 years old, how would you know about the folk music in the 1960s? The answer might be that a friend played it for you, and you might play it for your sister, who plays it for her school friends. We can see how this form of information dissemination is identical to the word-of-mouth marketing used by advertisers. The principles are same. One plays a particular song for a friend because one of the seven reward systems produce a payoff.

Broadcasters could use the same model that Butler used in constructing his BuzzCampaigns using BuzzAgents. Take the risk and let the market determine what and how to broadcast.

Dr. Barry Blesser is director of engineering for 25-Seven Systems. ■

READER'S FORUM

Going Mobile

A fellow contract engineer pointed me to your site, specifically Guy Wire's Internet Mailbag concerning HD Radio. I wanted to correct a few things you may be unaware of.

In a reply he stated (Oct. 10):

"Ford's new Sync technology is interesting and will no doubt eventually be a winner. But it's a very long way away from being able to deliver the same kind of reliable, uninterrupted and ubiquitous listening experience to the majority of average Americans that broadcast radio can."

That is untrue. While Ford/Microsoft's new collaboration is going to bring Internet radio to the masses, the product itself is not new, and the technology became available five years ago. It's not a "very long way away"; it's already here, and has been for some time.

I have "test driven" cellular 3G technology, and tested the feasibility of Internet radio in the car. My results suggest that *today*, as long as your in a metropolitan area, you can obtain near CD-quality streaming audio as you motor around town in your car, and not miss a beat.

Although the rural areas don't provide enough bandwidth for high-bit-rate, high-quality streaming audio, that is changing, as cellular companies are expanding their Rev A coverage at an enormous rate. Rev A 3G networks provide bandwidths up to 1.4 Mbps down/800 kbps up, which is on par with, and actually exceeds some of, today's land line "broadband" connections.

Also, with the Mini-ITX form factor PC available since 2002, or the new Pico ITX standard, it is, and has been, possible to have a functional PC no larger than your car stereo installed in your vehicle that can do anything from GPS navigation, Bluetooth cell phone hands-free operation, real-time vehicle diagnostics and [access] your entire music library available at your fingertips, to of course Web browsing and streaming audio and video — all driven by a touchscreen interface.

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—Next Issue of Radio World: December 19, 2007
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by Barry Blesser

Nothing Compares to Word-of-Mouth Buzz

The Technique Is Free, Powerful; Messages Are Effective When Delivered Within Personal Context

Consider that your current job gives you the feeling that your career is not advancing as fast as you expected, and that it is time to consider other possibilities. You ask two friends to keep an eye out for interesting opportunities and hope they will communicate with their friends.

Or consider that as a program director, you try an experiment with a new program format and you hope that over time it will gain in popularity. Perhaps a few listeners will find it exciting and they will tell their friends.

Or perhaps your son shows a real aptitude for being a sound engineer and wants to begin his career by producing a CD with some exciting new songs. He asks his friends to keep an eye out for talented musicians who are looking for an opportunity to produce their music.

In each of these cases, success depends on word-of-mouth marketing and publicity. If you communicate with three people, and if each of them communicates with three other people, and if they also in turn communicate with three additional people, your network grows exponentially: 3, 9, 27, 81, 243 and so on.

If the process continues for some time, eventually your message or question will have been distributed to thousands of people. The power of word-of-mouth is well known. Advertisers recognize it as one of the best and least expensive ways for distributing messages.

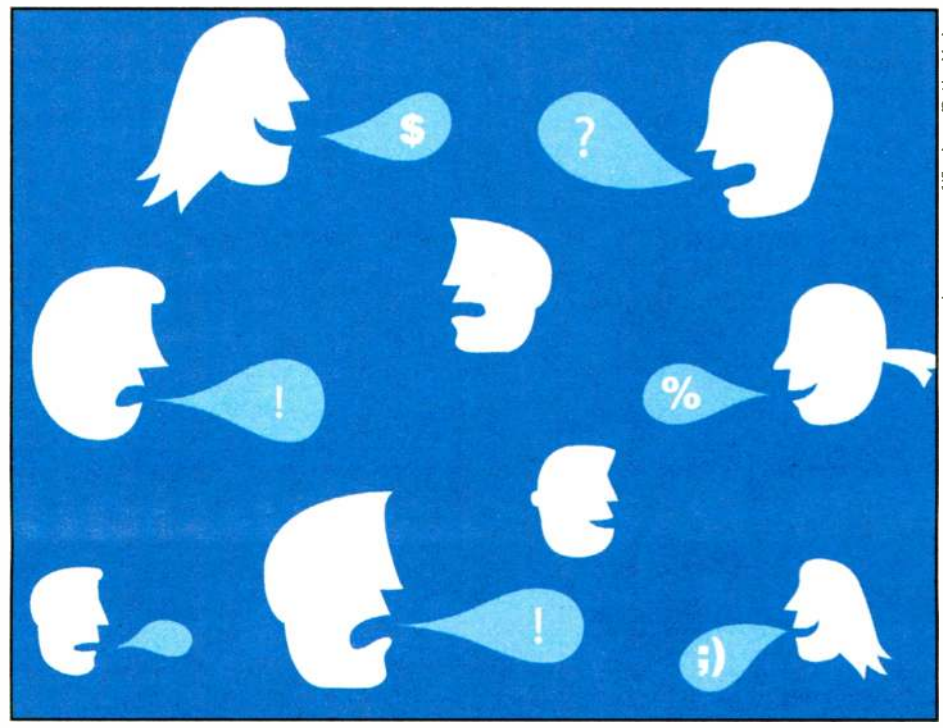
Like terrestrial radio and the Internet, word-of-mouth distribution is yet another form of broadcasting. Word-of-mouth is low-tech but potentially very effective.

Moreover, as I have commented many times here, terrestrial broadcasters must transform themselves into generic broadcasters using all types of information dissemination if they wish to survive. Word-of-mouth broadcasting should become another tool in the hands of information dissemination. The value of a service should not be linked to its technology.

The theory of word-of-mouth communications is so simple that everyone assumes they understand its dynamics. But there are many examples where this type of marketing completely fails to achieve the desired result.

WHAT MOTIVATES WORD OF MOUTH?

Most of us have, at one time or another, experienced failure in using this approach. You put the word out, and after a few months you notice there are no responses. And more than a few companies have invested millions in an advertising campaign that produced nothing in return.



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Success depends on word-of-mouth marketing and publicity, said Blesser: 'If you communicate with three people, and if each of them communicates with three other people, your network grows exponentially.'

Dave Butler, in his book "Grapevine: The New Art of Word-of-Mouth Marketing," examines the assumptions behind myths of this type of marketing.

After having heard the concept of word-of-mouth used throughout his marketing career, he began to realize that nobody actually understood its assumptions and the resulting dynamics. The question is actually simple: Why does a person bother to talk to someone else about an idea? Even though the answer is critically important, the answer is not obvious.

Butler quit his high-paying job as a marketing executive in order to start a small boutique firm that would focus on understanding the word-of-mouth dynamic, then capitalize on what he learned. His first task was to determine what motivates people to spread information.

All of us have, at one time or another, inadvertently participated in word-of-mouth communications, so we can ask ourselves what motivates us to tell someone about something. Butler identified several motivations including helping others, providing education, demonstrating knowledge, creating a social connection and validating one's own opinion.

If you want to use a grapevine to broadcast your message, you must package it in such a way that it appeals to at least one of these motivations. Without some kind of emotional reward, nobody bothers to pass along a message. The package and its contents determine the coverage area of your personal broadcast.

Butler provided many anecdotes that illustrated the power of motivation. As part of his marketing experiments, he used a large group of volunteers who were promised a tangible reward for achieving certain goals. Even though these volunteers worked hard and made a major contribution by submitting reports, they never bothered to collect their compensation even after Butler increased the value and made it easier to get paid. Strangely, they were not interested in any material compensation.

After much bemusement, Butler asked them why they ignored their rewards. The answer was simple, obvious and hard to believe. Their reward was the feeling that they were making a difference and that their opinions were highly valued.

In fact, Butler and his staff personally responded to each report, and that was the most important reward currency. People engage in disseminating messages if they feel relevant.

How does the concept of word-of-mouth apply to the broadcasting industry?

Like many media, our survival depends on letting the audience know that there is something of value that would be appreciated if known. While a broadcaster could handle advertising and publicity, nothing compares to having an audience that does marketing for you.

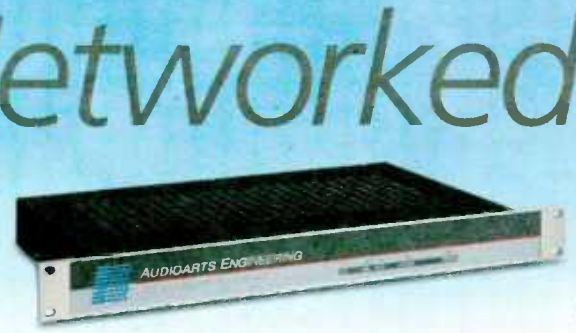
Not only is it free, but marketing is far more effective when a message is delivered within a personal context. Simple gimmicks, such as prizes and contests, are less effective than appealing to a real interest.

PIRATES AND PLAYLISTS

In an article in the Wall Street Journal this July titled "Pirated Music Helps Radio Develop Playlists," Sarah McBride described how Clear Channel Communications uses marketing data about popular downloads from illegal file-sharing networks to determine how songs are propagating through the grape-vine.

SEE BUZZ, PAGE 37

Networked / Independent



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