Radio Guide

Radio Technology for Engineers and Managers

May 2005

Digital Technologies Converge

Inside Radio Guide

All the signs were apparent at this year's NAB: Radio has arrived at a crossroads of major regulatory decisions. Several distinct and disparate paths confront us – some of them convoluted, some toll roads, and still others leading nowhere.

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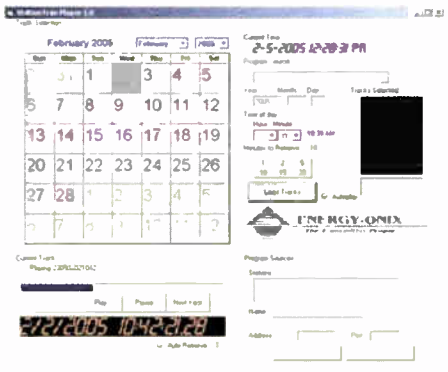

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Cover Photo: The Continental booth at NAB 2005 in Las Vegas. Shown left to right are: John Uvodich, Clay Freinwald, and Dan Dickey.

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Radio Waves

by Barry Mishkind – Editor

A Good Show for Radio

Most everyone who made it to the NAB show this year found something positive to carry home.

Perhaps the happiest were the manufacturers, many of whom noted a better return on their booth investments this year, as many delegates arrived ready to buy. There were even a few visible on Thursday.

The technology behind IBOC is truly starting to "shake down," and some of the difficult issues are being addressed. There is a transition going on and more have become adopters of the technology; Management seems especially energized by the vision of extra ad "inventory" from additional programs streams.

Equipment is "flying out the door" for installation around the country. More and more engineers are getting the "hands on" experience to begin evaluating the technology, and offering suggestions and demands for improvement. The move this year to take the analog signal out of the IBOC exciter is one good example of progress.

True, some feel it will be the third version that finally "gets it right," but BE and Nautel among others, for example, appear to be working hard to ensure the upgrade path is easier and less expensive than many feared.

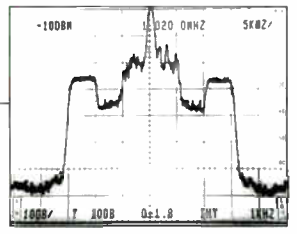
Still, many have reservations about the technology. Some fear a predicted "wave of interference" from IBOC sidebands; others question the economics of buying expensive transmission gear and receivers so listeners can hear ten spots in a row "in digital clarity."

Alternatives were in evidence on the floor. There was a lot of interest in a digital SCA product, and DRM operations appear to be gathering steam in Mexico. It will be interesting to see what develops.

All in all it was a good show for Radio. – *Radio Guide* –

Technology Guide

by Phil Alexander



Radio at the Digital Crossroads
How Much Regulation?

[INDIANAPOLIS, Indiana] All the signs were apparent at this year's NAB: Radio has arrived at a crossroads of major regulatory decisions. Several distinct and disparate paths confront us – some of them convoluted, some toll roads, and still others leading nowhere.

With no clear path in sight, new routes are still being discovered as our journey into digital broadcasting continues. The only thing we know for sure is once we move forward there is no turning back because the road behind us is old, overgrown and decaying. It is time for those who determine our course to make a decision about the branch we will take from this crossroads.

IBOC IS HERE

For me, the sub-text at the NAB was everywhere, especially in the meetings. It said, "*IBOC is here, get over it and get on with it.*" During the past year they changed the name to "HD" apparently trying to leverage from the digital HD-TV moniker that all consumers are beginning to learn, but the message was clear: call it IBOC or call it HD, our future is digital.

Some at the convention were nicer than others, but the underlying "get over it and get on with it" message was the same. For example, this year's NAB Radio Achievement Award winner, Milford Smith, very humbly accepted his honor at the NAB2005 Technology Luncheon and said "HD Radio is here, it works, and it sounds wonderful."

During his acceptance speech he announced that the NRSC-5 recommendation for digital audio broadcasting is complete and on its way to the Federal Communications Commission.

TIME FOR NEW RULES?

This may be the "other shoe" that will move the FCC to conclude Docket 99-325 with a Final Report and Order setting Rules for digital broadcasting.

Hopefully, NRSC-5 fulfills part (b) of the NRSC Digital Audio Broadcast Sub-Committee's stated objective: "to provide the FCC with an industry developed and supported standard that will aid in establishing final Rules for the implementation of IBOC technology in a manner that will best serve the public interest."

But, how many Rules do we really need? Is there a path to the future that will allow invention and innovation along the way to keep radio broadcast technology fresh and new, or must we be limited to today's technology? Already, multi-streaming known as "Tomorrow Radio" has emerged, and demonstrations of surround sound at the NAB showed another impressive direction.

OTHER CONSIDERATIONS

On the darker side, another potential AM IBOC problem got public recognition for the first time on a major stage. The theory of directional arrays teaches us that they cannot behave exactly the same way at all frequencies, and the upper and lower sub-carrier band of the IBOC AM signal are spread far from the carrier, especially on the lower end of the band.

Jim Moser, a Senior Staff Engineer at Kintronic Laboratories, presented a paper dealing with "phase bandwidth" or the uniformity with which it is possible to generate a directional pattern across various frequencies.

The importance of phase response in a directional system has always been very important for good quality AM sideband transmission, and becomes extremely important in some adjacent interference situations, especially at the lower frequencies of the band where the total width of the channel approximates 7 to 9% of the carrier frequency.

For comparison, that is about the same ratio of bandwidth to carrier frequency as a channel 3 analog video signal. It is more than double the bandwidth considered in conventional AM design for the best directional stations, and there are probably many AM stations where bandwidth beyond carrier performance was not given any kind of consideration because that has never been a requirement of the Rules.

WHERE IT MATTERS

Pattern bandwidth becomes a special problem in some of the newer, higher power, stations where customized patterns have coverage "notches" in them for protecting adjacent channel stations that are relatively nearby. This is especially important considering the IBOC sub-carrier radiation is directly within the adjacent channels.

While a station may meet the NRSC-2 mask limits in its major lobes, the same cannot be said for nulls unless the pattern is very "phase stable" across its entire bandwidth. It is easy to imagine measuring an IBOC sub-carrier to carrier ratio 10 or even 20 dB above the mask limit in a null designed for protection of an adjacent channel station.

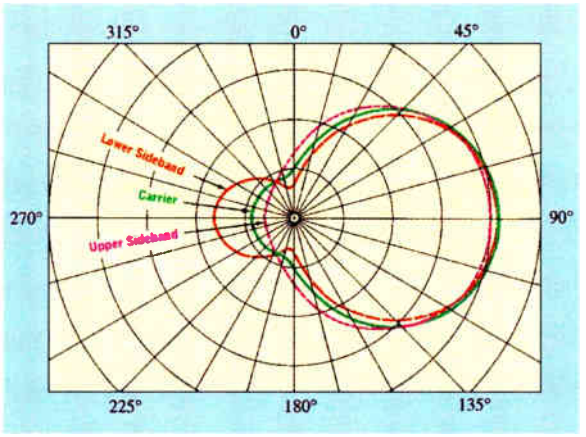


Figure 1 – Poor Bandwidth Response

This problem can become very demanding when a high-powered, many-towered directional array transmits what is essentially co-channel interference toward a relatively nearby "adjacent" station. In fact, preventing *daytime interference within the City of License* of a station assigned to a channel adjacent to one of these carefully contoured arrays may be a daunting task in some cases.

Thus, it is clear that AM-IBOC will face interesting interference challenges in both daytime and nighttime operations in some cases.

STANDARDS

Another objective binds the NRSC, "to develop formal NRSC standards that will furnish broadcasters and manufacturers of both broadcast and receiver equipment with a complete and open transmission and reception specification of the AM and FM IBOC systems, providing a clear path for the prompt adoption of this technology and ensuring that all IBOC equipment will be suitable for the hybrid, extended hybrid and all-digital modes of the IBOC system."

That objective was stated a few years ago when it seemed there would be inter-operational compatibility between the IBOC and DRM (Digital Radio Mondiale) modes of transmission that share the same basic COFDM/QAM technology.

In fact, Texas Instruments already has a chipset with COFDM/QAM/QPSK demodulation and forward error correction capability. Meanwhile, there are rumors of Ibiquity scurrying to develop a single purpose chip aimed strictly at "HD" radio use.

During the NAB a second undercurrent seemed to be a feeling that Ibiquity's IBOC/HD solution would be "*the*" solution for digital radio in this country. While that might seem sensible for Ibiquity, a single purpose solution for a company like Texas Instruments makes little sense in the international market where other digital solutions such as DRM are gaining favor.

WHOSE STANDARDS?

DRM recently announced a program for extending their upper frequency limit to 120 MHz and several of the transmitter manufacturers announced their compatibility with DRM in the AM broadcast and shortwave bands. Furthermore, DRM has moved a bit more strongly into our hemisphere with announcements of experimentation in Mexico.

Taking these events into account, it appears the rest of the world may not see IBOC as "their" solution for making the digital radio transition. This is a wake up call saying we need flexibility for the future.

Perhaps, the general release of the NRSC's IBOC recommendation will answer all questions about the future of digital broadcasting in the United States. If we are fortunate, their original goal of an open system may be preserved.

If not, however well intended, and however well developed, setting a detailed standard for a single form of digital audio broadcasting based on today's technology may be an unnecessary mistake. Yes, I can hear the chorus asking, "Unnecessary? Don't you remember the fiasco we called 'AM stereo?' That proves we need digital standards."

LEARNING FROM THE PAST

Technology has changed remarkably during the past generation. When our industry began debating a transition to digital radio well over a decade ago, the failure of a "let the market decide" approach to AM stereo was a bitter lesson to all who had been involved, and it was clear that a repeat could not be allowed to happen again.

A generation ago, rules for AM stereo might have prevented the chaos. But, does that mean we need to confront the same problem and solve it the same way now? Listening to the presentations at this year's NAB Radio Engineering Conference and others at the convention, it is clear that technology moves faster than its users. While many people remain stuck in the problems of past technology, science and technology progresses at an ever increasing pace.

One of the few things on which all panelists on the NAB surround sound panel agreed was that IBOC is not your father's AM stereo revisited. Software is the reason. While AMS was essentially hardware dependent, there is no hardware dependency for IBOC beyond the transmission basics; in other words development of the digital sub-carriers for the data stream the listener's set will decode.

NEW TECHNOLOGY

Microprocessor technology makes the difference. The information modulated on digital sub-carriers and the use the listener's set makes of them are naturally and fundamentally software/firmware functions.

What is done with the bit stream after demodulation can easily be handled by a software layer above the underlying hardware data transport system that must be part of the IBOC "standard." In fact, the interim IBOC system we are now implementing across the industry is really, a layered system.

The first layer is the extended channel established by the FCC for digital use. This is the spectrum inside the NRSC mask. This layer is entirely hardware dependent. The transmitter must generate the signal, modulate it and faithfully amplify it. The transmission system must then radiate signals without distortion, particularly without intermodulation distortion that increases sub-carriers above the limits of the NRSC mask.

The IBOC receiver also must include linear amplification and wide band demodulation as part of its design, but beyond these hardware requirements the technology exists for defining the rest of digital radio *in software.* And, except for a standard means of transmitting and receiving updates, software needs few Rules and Regulations. The differences between the Ibiquity "HD" radio system and DRM are, or can be, variations in *software.*

(Continued on Page 6)

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Technology Guide

by Phil Alexander

Continued from Page 4

SOFTWARE SOLUTION

Ibiquity, the FCC, the NRSC, the set makers themselves and their chip suppliers provide flexibility for software/firmware reprogramming; IBOC broadcasting can evolve in an open and dynamic way that takes advantage of the latest technical advances as they develop.

On the other hand, if FCC Rules restrict us to IBOC/HD radio as it now exists (as defined by the Ibiquity system), that closed system may become the stumbling block that stifles innovation and forces the next generation of radio broadcasters into yet another confrontation with obsolete technology twenty years from now.

Open technology needs a uniform way of updating receiver software/firmware. This might be done in a number of ways, but a low baud rate over-the-air method seems compatible with our present technology. As technology develops, radios will look more like computers and less like the radios of the 20th century.

However, if we freeze our progress at the IBOC stage, the possibility of losing our development "edge" looms large. That begs the question of a repeat of the AM stereo debacle that no one wants; but a review of present day technology answers that question convincingly, and says creating a similar situation with today's technology would be very difficult indeed.

Remember that the DRM consortium has announced a development project for VHF up to 120 MHz. That competition could lead to better transmission in the FM band. Competition usually has that effect.

FLEXIBILITY IS IMPORTANT

If the FCC Rules permit flexible transmission and a standard way of updating receivers for new demodulating/decoding programs, and digital radio receivers are capable of receiving several different modes *in a way that is completely transparent to the listener*, then domestic radio can evolve to become the best system, and a world leader in digital radio transmission.

Flexible transmission Rules and "smart" adaptable receivers can open the way to technical evolution wherever it leads. Listeners can truly decide what they like, want and need. Stations will be free to adapt to satisfy their listeners with multiple program streams, better CODECs with higher fidelity and surround sound, and every other idea that is yet to be invented.

Independence and flexibility in the software layers may also be an answer to some of the more perplexing transmission problems that threaten to plague AM radio during the transition to digital broadcasting. For example, suppose a severe interference problem exists on one side of a station's carrier but the conflict on the other side is only marginal and similar to most other stations.

In this situation, the offending station might be forced to discontinue IBOC transmissions until the end of hybrid operation. In other words, that station might not be able to participate in digital radio for several years because IBOC does not provide an alternative.

SMART RECEIVERS

On the other hand, "smart" digital receivers offer another alternative.

A station causing unacceptable interference using the IBOC mode could use a DRM mode that puts analog information on one side of the carrier with digital subcarriers on the other side, avoiding a clash with an adjacent station on one side of its carrier. With digital processing technology the receiver could recognize the signals and route the sidebands to the correct demodulators.

In this scenario the listener selects the station's frequency while the digital processing in the receiver chipset does the rest. There would be no knobs to turn, no switches to flip, no listener confusion. The listener selects the station, sets the volume – and listens. All sets would receive all stations regardless of transmission mode.

An open system can lead to the latest and best technology *as it develops* and is no more difficult than making clever use of *present day* technology.

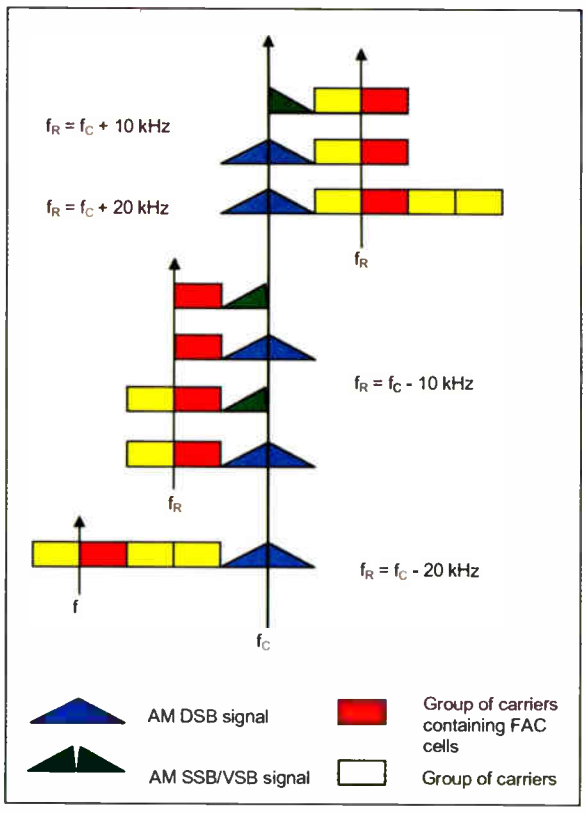

Figure 2 – DRM Analog Simulcast Modes

The path we take from the crossroads before us can be bright, open and endless, or it can be a dark and dreary one leading to a dead end. The technology is here, the ideas are here and will keep coming for as long as we have clever design engineers who say, "Why can't we do better?"

The rest is up to the FCC, and both the history of the computer revolution and the technology argue that the *best* regulation is the *least* regulation in an *open* system.

New technology interests Phil Alexander. His hope is that it brings not just change, but positive change for the radio industry. Comments? Contact Phil at: dynotherm@earthlink.net

Digital Guide

by Robert Meuser

Digital Transmission

Part 4: EER – Envelope Elimination and Restoration

[NEW YORK CITY, New York] Let us briefly review where our discussion on digital transmission has led us so far.

MOVING DIGITAL AUDIO TO RF

We began by looking at how a digital stream can be transmitted in narrow bandwidths by having the RF carrier represent various digital values with specific analog values of both amplitude and phase. Often, this technique used is called QAM.

By further breaking out the bit rate – over interleaved carriers – we can have a more rugged means of transmitting the digital information. This technique is known as OFDM. This led into a discussion of how both the QAM process as well as the OFDM process requires linear amplification of the resulting signal.

Last month we touched on the issues of VHF transmission where a linear amplifier is required to transmit this signal. This means the resulting signal is much like running a TV transmitter and can lead to a loss of efficiency and power output relative to analog transmission. That explains why, in medium wave transmission, the EER technique is the preferred method of amplifying digital signals.

EER

The last installment briefly touched on the basic elements of the EER system. While EER seems relatively straightforward in concept, the devil is in all the details.

When a signal is either broken into amplitude and phase components or a digital process generates the equivalent signals, the resulting signal is more complex than the individual components. Basically these signals contain distortion components that must ultimately cancel out if the EER method is to be successfully used for linear amplification.

A real world EER system needs to accommodate equalizing the two paths. Since the amplitude components must pass through the AM modulator stage of the transmitter, they are affected by the phase and frequency response of the specific transmitter's modulator.

When real world AM transmitter operation is taken into account, this can often include the pass band characteristics of the antenna system. The phase or RF component is passing through the RF chain of the transmitter, which has completely different frequency and phase response. In its raw form the EER concept does not work on real world transmitters. Something more is needed.

REMEMBER AM STEREO?

Those who remember AM stereo installations will recall a similar problem. While most AM stereo systems did not use a pure EER approach, a somewhat related set of amplitude and phase components also needed to be matched after passing through two different paths in the transmitter.

In the case of AM stereo exciters, analog equalizers were used to correct for amplitude, phase and time delay differences in the two paths. Those who have done AM stereo installs will easily remember the difficulty in precisely establishing the necessary match.

Many might also recall some audio processors from the 80s employed a similar form of equalization to improve the waveform response of the analog path only. With digital broadcast exciters, there is the power of DSP processing to perform the equalization, also called pre-correction in the digital broadcast world.

Equalization can only help so much. For digital transmission to work successfully the transmitter must meet certain minimal requirements. On the amplitude side, the audio frequency response be greater than ultimate channel width. Ultimately this will also include the path through the antenna.

BANDWIDTH AND COUPLING

In the case of the Ibiquity IBOC approach, some manufacturers claim that an audio response to 50 kHz is required. Obviously there is a similar response requirement for the RF path. A transmitter transmitting DRM would require less bandwidth as the digital components cover a spectrum of 10 to 20 kHz rather than the 30 kHz IBOC presently requires.

Another requirement for a pure EER system is that the transmitter be DC coupled. While modern transmitters have the capability, there is often some form of DC blocking added to protect from DC offset in devices driving the transmitter. If a transmitter is truly DC coupled, you should be able to put an adjustable DC power supply at the audio input and cause the transmitter to have a pure carrier at any power level from zero to the overload point.

Very few older transmitters will play well. Anything with a plate modulator is out, as are newer technology PDM types, which had a difficult time adding AM stereo. In practice, the newest PSM variants and updated PDM designs certified by the manufacturer for digital transmission will be the type of transmitters presenting the fewest conversion issues.

Even if the transmitter design is up-to-date, the antenna may present anything from a challenge to an insurmountable problem. In addition to all the obvious issues, certain transmitters may not deal well if the digital operation causes excessive VSWR to exist at higher frequencies. This could result in anything from a power fold-back to a fast remodulation of the signal and off-channel IM distortion.

OLD SKILLS SERVE THE FUTURE

To sum things up thus far, even though digital radio is about sending ones and zeros, those bits first become a quasi analog signal that often require a lot of finesse to actually get them on air.

Virtually everything ever used in the past to improve the audio wave form response, make a transmitter play well with the antenna or make AM stereo play properly will also be among the skills needed to keep a digital transmission plant playing properly.

AM engineering is certainly not going away. The standards are just more demanding in digital. Interestingly, those FM engineers who have avoided dealing very much with AM will need to think more in AM terms as well as dealing with those issues specific to VHF transmission.

Robert Meuser is always keen to follow and help others understand the latest technologies for broadcasting. He welcomes your comments at robertm@broadcast.net

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Radio.edu

A Non-Comm View

by John Devecka

I Gave My Feet for You

NAB Best Finds 2005

Radio.edu is written to focus on the needs of college and non-commercial stations. However, because dealing with limited budgets is not just a non-comm issue, John Devecka's observations on new technology can be of help to all sorts of stations and studios.

[LAS VEGAS, Nevada] Every year a dedicated group of crazies heads to Las Vegas to dehydrate ourselves, flatten our feet, see giant bats, tote back-breaking loads and pay $6 for a hotdog – all so we can find out about the next big thing, or the most interesting new tools for our stations.

There always are a zillion new things at NAB; picking the most interesting ones is always a challenge.

Some of those tools are even available to purchase, some are not quite out of beta stages, and some of them never will make it *that* far.

THE QUEST

I tried to find products that were both interesting and reasonably close to availability, but I wanted things that were useful for those of us in the educational radio sphere, where we are often working on small budgets and with students in mind.

The products I liked ranged from simple connectors to configurable digital interfaces, and from $5 to nearly $10,000.

This year there was an even bigger bunch of digital radio equipment, in both ready and "launching soon" stages. "HD Radio" products were popping up in a lot of places; although it is still an answer to a question no one asked, it seems like everyone wants a piece of that pie.

SMALL PACKAGE, BIG CONVENIENCE

We start with some little things, because those are what holds the station together. The folks at Switchcraft have put a twist on the standard (and right angle) XLR connector this year. This simple change makes it easier to wire up and should provide very reliable strain relief.

The three-piece assembly includes a revised clamping internal plastic grip frame, with serrations that mate to the serrated end of the solder lugs/pins. This combines with the rubber strain relief in the connector body to keep the wires from torquing while being tightened.

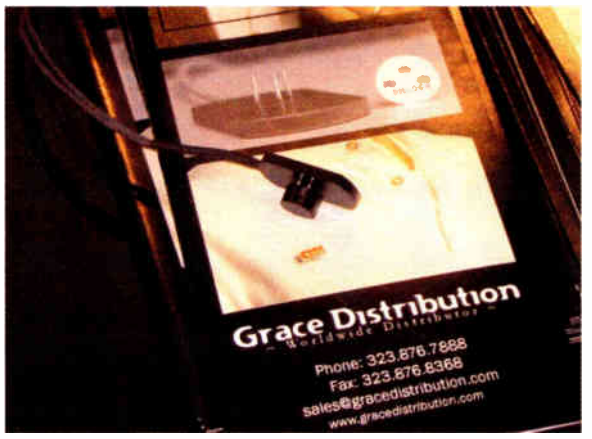
New XLR assembly from Switchcraft.

The finished connector also, quite sensibly, has a pair of flat spots on each half of the outside which enables one to tighten with pliers and not worry about either slipping or scarring the connector while getting a solid twist to close it up. Yep, it is the little things that make a difference – and it is nice to find something new at NAB that is less than $5!

VERSATILE MICROPHONE

We have started doing more sports and interview projects for our campus radio and TV stations, and lavalier microphones are a critical component in these jobs. We needed a nice subtle solution to use, and at a reasonable cost.

While wandering around the edges of the radio exhibits, I stumbled onto Grace Distribution's lapel microphone. It is quite a clever design. The three pins for the balanced microphone are sharpened and the microphone head pulls off of them. This allows you to pierce a tie, shirt, lapel, etc. with only the tiny head of the microphone showing.



Tie Microphone mounts with no wire showing.

More intriguing, however, is that the design is omni-directional around the perimeter of the microphone rather than on the face. This means you can cover the microphone with a glued on button, logo pin, jewelry or other bit to hide it completely in an interview.

While this does allow for some interesting ambush potential, more importantly it can allow for comfortable discussions, without the awkward "feeling" a visible microphone can bring to a conversation.

The microphone head is smaller than a button.

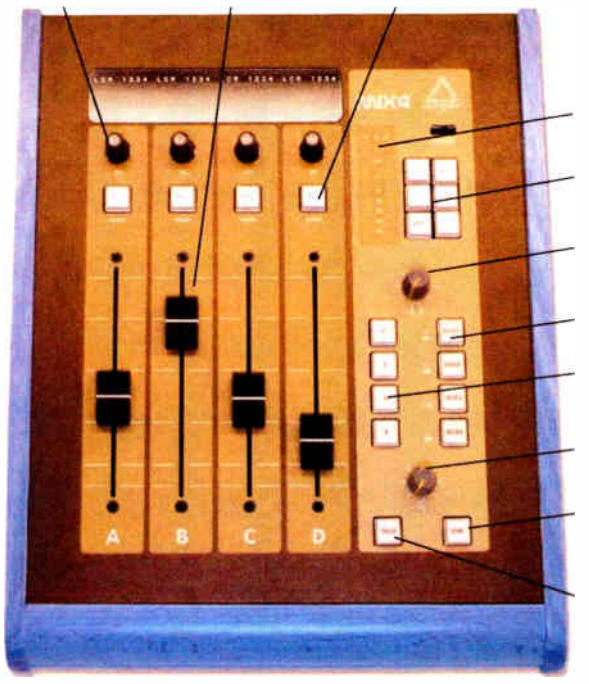
At about $250, this can provide a snazzy concealed package for micing referees, roving reporters, etc., while allowing you to put your logo in front of people, and get good audio in the field. Combine this with a handheld interview microphone and you can put together a very nice field package for roving event interviews. (More info at www.gracedistribution.com)

SMALL DIGITAL CONSOLE

Digital consoles were everywhere this year, in plastic, aluminum, wood, and with every manner of meter style and color scheme. It seems many manufacturers are developing small consoles with routers inside (or nearby in a rack). I was looking especially at options for small control surfaces, with easy configuration that a student could handle.

One console I saw last year is now a real, shipping, product (unlike many shown this year) and its price is pretty reasonable. Junger Audio in Germany has released the MIX4 console system, based around a 4-fader control surface and audio interface rack unit.

The MIX4 has a variety of selectable cards for the audio interface, offering 2 microphone and 10 stereo inputs (a user determined mix of analog and AES/EBU) and all the connection to the control surface is done with a single Cat-5 cable.



MIX4 from Junger audio.

I like this console for several reasons: it is small, simple and flexible, but also simple enough for the average student operator. It has a lot of critical functions, from a telephone interface to multiple buses, memory settings for different DJs as well as components, analog and AES/EBU ins and outs. On top of it all, how about audio processing for each input that can follow in memory?

The MIX4 has a very intuitive layout and its controls are not so complex as to intimidate. If you want to make a flexible studio for news, voice tracking, production or even a small air studio, this will do it. Adding in a microphone, PC, CD and telephone hybrid, you have a complete multi-function studio with a simple interface and big flexibility - all for about $5,000. (More info at: www.junger-audio.com)

AUDIO OVER IP

We recently discussed remote broadcasting equipment in this column, and ways to bring home your material from far away. A new player in town is the AudioTX STL-IP from MDO UK. It is distributed by Broadcast Warehouse.

The Audio TX

These units allow you to send audio with a variety of sample rates and codec styles (all software controlled in easy drop down menus) over networks at up to 24 bits, giving you the option of permanent or portable linking to your station. Whether you want to just use your network to set up a permanent STL over IP, or you want to broadcast games from other campuses, this is something to consider.

(Continued on Page 10)

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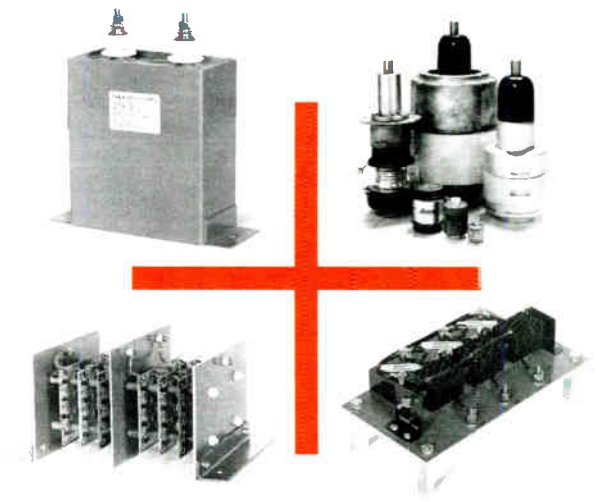

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A Non-Comm View

Continued from Page 8

Pricing is about $2,900 per end for these 1RU boxes and they are directly web addressable for configuration. These look like a very interesting option for those that find ISDN difficult to acquire on the fly and want more than POTS audio quality, or for those of us that need to get a reliable audio path between remote campuses.

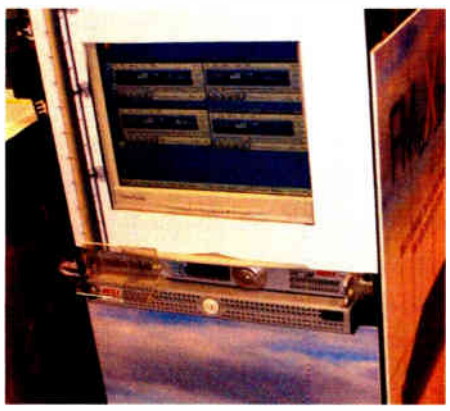
Why not get several schools together and set up these boxes at each one? Then you would have a neat remote audio network available for touring teams, with far less headache than getting ISDN each time you arrive on site and selectable codecs based on your needs and format. (More info at: www.bwbroadcast.com)

DIGITAL SCA WITHOUT IBOC

The final product I want to discuss is also the most expensive. At an entry point of $8,900, plus receivers, it is not cheap, but it sure is interesting. The FM eXtra from Digital Radio Express (www.digitalradioexpress.com) offers a solution for non-commercial FM stations (and others) that want to improve their subcarrier value, and still not commit to IBOC digital radio.

Their system replaces your analog SCA operations with several (you decide on the sectioning) digital subcarriers totaling up to 128k of bandwidth. You decide on the encoding you want to use, set the bandwidth usage for each of them and away you go. The system even offers a digital ID in the stream that allows smart receivers to find it automatically. The demo was running 4 streams of AAC at 32k sampling. It sounded no worse than most subcarriers and there were *four* streams available (think of the revenue!).

Interesting opportunities abound with this system. Say you are a licensed station and you need to reach lots of remote transmitters, or you are interested in leasing your licensed station's subcarriers. Using these systems, you can run a stereo digital audio feed to your remote locations, providing a high quality feed that is more reliable and less long-term expense than dry pair leased lines.



FM eXtra running four streams.

Want to generate sports revenue and listeners without knocking off your traditional DJs? How about running your sports broadcasting on the subcarriers, and sell the receivers to interested folks? Or better yet, contact a local sporting goods chain (or national group) and sell them ad spaces to cover the costs of the radios?

It is a bit early for the radios; their cost is still at the $100 mark. But bulk buys using sponsor money should help knock that down fast. And, if you run a variety of subs, you can lease them out to local groups for a real revenue stream. You could even use this system to create a variety of podcast streams, if you wanted to be hip.

NEXT YEAR IN LV

NAB is always an interesting excursion. Whether you are looking for specific products or just gauging the industry's next trends, it is worth the pain. Perhaps we will see you there next year.

Bring your most supportive shoes, lots of water, and a notepad. But leave your wallet at home – it is just too dangerous to bring one of those to Vegas.

John Devecka is the Operations Manager of WLOY at Loyola College in Maryland. His feet hurt and it will take about 11 months to forget the pain. If you saw interesting radio products at NAB, let him know - there was simply too much for any one person to catch, even John. John's new email: john@radioedu.com

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DA Q&A

By Ron Rackley, P.E.

Specifying the Right Reference Tower

[SARASOTA, Florida] **Question: If the FCC Construction Permit for a new Directional Antenna (DA) shows that tower 1 – the end tower of the four-tower in-line array – has a ratio of 1.000 and a phase of 0.0 degrees, just as was shown in the original application, why might the station still need to order an antenna monitor specifying a different tower as the reference tower?**

Answer: The antenna monitor's reference tower – the one that always has a ratio of unity and a phase of zero – should be the one with the most stable parameters, to minimize the "dog chasing tail" effect as adjustments are made. FCC Construction Permits (CPs) specify theoretical parameters without any consideration of which tower should be used as the reference tower for the antenna monitor.

IDENTIFYING THE REFERENCE

The problem here is that there are different considerations for choosing the reference tower in different contexts.

When designing a new DA pattern, the choice is one of convenience for doing the pattern calculations. When adjusting the pattern, it will be much easier to understand what the phasor controls do if the reference tower on the antenna monitor is chosen to be the one with parameters that move the least as the other towers' parameters are adjusted. The best tower for one is not necessarily the best tower for the other.

When a new pattern is being designed, any tower can be made the reference tower by simply assigning a ratio of unity and a phase of zero to it and then specifying the parameters of the other towers to have the correct relative ratios and phases. It is a matter of choice for the designer.

Multi-tower patterns designed by the "pair multiplication" method generally use the tower that is most conveniently chosen as the common tower within the calculation pairs as the reference tower. For this reason, many designs use the number one tower – an end tower of an inline array or a corner tower of a parallelogram – as the reference tower, even though it may be the worst possible one to use as the parameter reference while adjusting the antenna system.

USER'S CHOICE

When an Application For CP is filed, the DA design parameters are submitted to the FCC – where they are ultimately used to generate the CP document (if it is granted). This does not settle the issue of which tower should be chosen as the reference tower on the station's antenna monitor.

That question needs to be considered before the antenna monitor is ordered, as its reference tower will often need to be a different one than is specified by the CP theoretical reference parameters. (Because of mutual coupling between the towers of a DA array, all of the parameters change to some extent with every adjustment.)

Some towers are more sensitive to adjustments that are made to adjacent towers than are others. The towers of an array have differing base impedances, depending on the mutual impedances between them and the ratios and phases of the currents fed into them to produce the required radiation pattern.

POWER VS. RATIO

The power division can be quite varied, with one or more of the towers taking most of the input power and the rest of them dividing what remains. It is generally considered to be good practice to choose the tower with the highest power as the reference tower of a DA pattern. (The tower with the highest ratio is not necessarily the one with the highest power.)

Some towers may not require much power to be fed to them to produce their required parameters, while certain ones receive more power than they radiate from mutual coupling and must feed it back into the system. It is the high power towers that are the least sensitive to parameter changes in the other towers, while the low-power and negative power flow towers are the most sensitive.

Thus before a new antenna monitor is ordered, consideration should be given to which tower will be the reference tower for each DA pattern (Where more than one pattern is in use, it is sometimes necessary to use a different reference tower for each one). Calculations must be made to determine the expected operating base impedances and power division when a new phasing system is designed, and that is also the best time to consider the antenna monitor reference tower question.

Ron Rackley finds directional antennas fascinating, and is happy to share his thoughts. However, due to his existing commitments and travel schedule, he regrets being unable to reply personally. If you have suggestions for future topics, please send them to editor@radio-guide.com

Leading POTS Codecs Compared.

	Comrex Matrix	Tieline Commander	**Zephyr Xport**
Audio Bandwidth @ 24 kbps	14 kHz	15 kHz	**15 kHz**
@ 19 kbps	11.2 kHz	9 kHz	**15 kHz**
Direct Internet Software Updates	No	No	**Yes, via Ethernet port**
Digital PC Audio Input	No	No	**Yes, via Ethernet port and supplied driver**
Audio Metering (XMIT/RCV)	Transmit only	One-at-a-time	**Simultaneous**
Audio Processing	None	Simple AGC	**Digital multi-band AGC with look-ahead limiter by Omnia**
Remote Control	No	RS-232 and dedicated computer	**Ethernet via Web browser**
Auto Dial Storage	19 Numbers	50 Numbers	**100 Numbers**
Frequently-Used Settings Storage	none	none	**30**
Standards-based POTS Codec	No - Proprietary	No - Proprietary	**Yes - aacPlus (MPEG HEAAC)**
Transmit-Receive Quality Display	No	Yes	**Yes**
Contact Closures	2	2	**3**
Display Resolution	120x32 LCD	120x32 LCD	**128x64 LCD**
Analog Cell Phone Interface	Optional	Standard	**Standard**
Mixer Inputs	1 mic, 1 mic / line	2 mic / line	**1 mic, 1 line**
Phantom Power	No	No	**Yes - 12 volt**
Automatic Voice-Grade Backup	No	No	**Yes**
Power Supply	External	External	**Internal auto-switching**
Local Mix Audio Outputs			
Headphone	Yes	Yes	**Yes**
Line Level	Yes	No	**Yes**
Direct Receive Audio Output	No	Yes	**Yes**
Uses ISDN at the Studio Side for More Reliable Connections	No	No	**Yes - your Zephyr Xstream becomes universal POTS and ISDN codec.**
Available ISDN Option	$850.00 (adds MPEG L3 & G.722)	$850.00 (adds G.722)	**$495.00 (adds G.722 & state-of-the-art AAC-LD for high fidelity and low delay)**
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Getting Together as an Industry

[LAS VEGAS, Nevada] It has been a very busy spring. In addition to the NAB show, several of the State Broadcast Associations held their annual meetings over the past couple of months. For example, the Michigan Association of Broadcasters held the Great Lakes Broadcast Conference and Expo in March.

Compared to the NAB's official 100,000+ registered attendee figure, the 1399 that gathered in Lansing, MI might seem small. But both have their place, and emphasis on helping engineers understand the changing technologies and challenges to getting their jobs done each day.

TECHNOLOGY EXPLAINED

It is quite interesting to see how some of the manufacturers are reaching out to help the folks in the field. Since it is not always possible to attend the big show in Las Vegas, these smaller gatherings are very important, as they reach down to the very techs who are in the greatest need of educational opportunities.

In Lansing, for example, the MAB made arrangements for a very valuable day of instruction. At least 168 engineers benefited from an IBOC upgrade tutorial from Ted Lantz of BE, and digital processing information from Frank Foti of Telos/Omnia.

Ted Lantz explains digital transmission at the MichMab Conference.

Larry Estlack moderates a discussion with the FCC folks at MAB Expo.

Chris Arnaut from WJR had a very useful series of tech tips on handling problems without spending much (or any) cash. And the opportunity to speak with the local FCC Field Agents allowed stations to get answers before the inspection!

The hospitality at the MichMab Expo was quite impressive. Instead of the $6.50 hot dogs found at many conventions, on both days MichMab provided plenty of food and drink on the floor of the Exhibition Hall for everyone.

MIXING KNOWLEDGE AND FOOD

It is a fact: engineers do love to eat. But it was not the food the brought in a full house to the Nautel Users' Group gathering on Sunday morning before the NAB show. Nautel put on a solid presentation covering both the latest digital tech, as well as a font of superb tips and tricks to help maintain their gear.

Nautel's NUG Meeting

And, yes, the majority of the attendees found the lunch to be quite satisfying, too!

Other opportunities to learn included the Broadcast Electronics information and cookie gathering on Saturday afternoon, and of course, the NAB sponsored sessions, which included a full afternoon on digital transmission, and a lot more.

Of course, while eating and learning is good, eating and networking might even be more fun. The Annual Lunch Gathering on Tuesday found more than a hundred folks enjoying the opportunity to meet and greet folks they usually only get to "meet" via email. Co-sponsored by Prophet Systems, Shively Labs, Nautel and Orban, even those that did not get a Prophet Jacket, a copy of Microsoft Office 2003 or Linspire, or a copy of *Apple Annoyances* from O'Reilly Media went home winners: everyone received an AC Sniffer from Radio Guide.

Good food, good chat, good friends.

More pictures of the Lunch are available on the Internet at www.oldradio.com/nab.htm

HONORABLE MENTIONS

A couple of honors given out seem worth mentioning: Greater Media's Milford Smith received the Radio Engineering Achievement Award at the Technology lunch. And, Dick Burden was given the LifeTime Achievement Award by the SBE in recognition of over 55 years work in the broadcast engineering field.

Dick Burden

If you were not able to make it out to Las Vegas this year, see if you can make room in your schedule for your state gathering. And next year, maybe you can make Las Vegas, too.

The routing switcher gets a new twist.

(About five twists per inch, actually.)

Everybody needs to share audio. Sometimes just a few signals — sometimes a few hundred. Across the hall, between floors, now and then across campus. Routing switchers are a convenient way to manage and share your audio, but will your GM really let you buy a router that costs more than his dream car? Unlikely.

If you need a routing switcher but aren't made of money, consider Axia, the Ethernet-based audio network. Yes, Ethernet. Axia is a *true network*. Place our audio adapter nodes next to your sources and destinations, then connect using standard Ethernet switches and Cat-6. Imagine the simplicity and power of Ethernet connecting any studio device to any other, any room to any other, any building to any other... you get the idea.

Routers are OK... but a network is so much more modern. With Axia, your ins and outs are next to the audio, where they belong. No frame, no cards, no sweat.

Scalable, flexible, reliable... pick any three.

An expensive proprietary router isn't practical for smaller facilities. In fact, it doesn't scale all that well for larger ones. Here's where an expandable network really shines. Connect eight Axia 8x8 Audio Nodes using Cat-6 cable and an Ethernet switch, and you've got a 64x64 routing switcher. And you can easily add more I/O whenever and wherever you need it. Build a 128x128 system... or 1024x1024... use a Gigabit fiber backbone and the sky's the limit.

Are you still using PC sound cards?

Even the best sound cards are compromised by PC noise, inconvenient output connectors, poor headroom, and other gremlins. Instead, load the Axia IP-Audio Driver for Windows® on your workstations and connect *directly* to the Axia audio network using their Ethernet ports. Not only will your PC productions sound fantastic, you'll eliminate sound cards and the hardware they usually feed (like router or console input modules). Just think of all the cash you'll save.

Livewire

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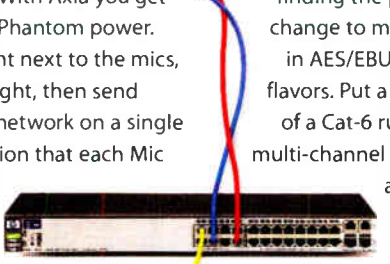
There's a better way to get audio out of your PC. No more consumer grade ¼" connectors – with Axia your digital audio stays clean and pristine.

Put an Axia Microphone Node next to your mics and send preamplified audio anywhere you need it, over Ethernet — with no line loss or signal degradation.

Put your preamps where your mics are.

Most mainframe routers have no mic inputs, so you need to buy preamps. With Axia you get ultra-low-noise preamps with Phantom power. Put a node in each studio, right next to the mics, to keep mic cables nice and tight, then send multiple mic channels to the network on a single Cat-6 cable. And did we mention that each Mic Node has eight stereo line outputs for headphones? Nice bonus.



Put your snake on a diet.

Nobody loves cable snakes. Besides soldering a jillion connectors, just try finding the pair you want when there's a change to make. Axia Audio Nodes come in AES/EBU and balanced stereo analog flavors. Put a batch of Nodes on each end of a Cat-6 run, and BAM! a bi-directional multi-channel snake. Use media converters and a fiber link for extra-long runs between studios — or between buildings.

An Axia digital audio snake can carry hundreds of channels of digital audio on one skinny CM-6 cable. We know you're not going to miss soldering all that multi-pair.

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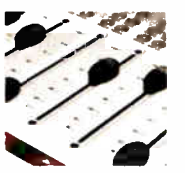
Axia is already working with some great companies. Like Enco Systems, Scott Studios, Radio Systems, Balsys Technology Group, and of course Telos and Omnia. Check AxiaAudio.com/partners/ to find out who's next.

With a little help from our friends.

A networked audio system doesn't just replace a traditional router — it *improves* upon it. Already, companies in our industry are realizing the advantages of tightly integrated systems, and are making new products that reap those benefits. Working with our partners, Axia Audio is bringing new thinking and ideas to audio distribution, machine control, Program Associated Data (PAD), and even wiring convenience.

Would you like some control with that?

There are plenty of ways to control your Axia network. For instance, you'll find built-in webservers on all Axia equipment for easy configuration via browser. PathfinderPC® software for Windows gives you central control of every audio path in your plant. Router Selector nodes allow quick local source selection, and intelligent studio control surfaces let talent easily access and mix any source in your networked facility.



Control freaks of the world, rejoice: intelligent Axia mixing surfaces give talent complete control of their working environment. Reconfigure studios instantly and assign often-used sources just where they're most useful.

"This sounds expensive." Just the opposite, really. Axia saves money by eliminating distribution amps, line selectors, sound cards, patch bays, multi-pair cables, and tons of discrete wiring — not to mention the installation and maintenance time you'll recover. And those are just side benefits: our hardware is about half the cost of those big mainframe routers. That's right... *half*. Once you experience the benefits of networked audio, you will never want to go back. AxiaAudio.com for details.

AXIA

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by J.S. Sellmeyer, P.E.

Improvements to Sample Loop Connector Assemblies

Maintaining directional antennas depends upon having accurate data samples from the system. However, sometimes, it is the very tools and systems we depend upon that can create problems. Jack Sellmeyer shows one such potential issue, and how to improve the system.

[McKINNEY, Texas] Certain sample loop connector assemblies have been known to exhibit erratic loop current and/or phase indications after a few years in service. This article will discuss possible reasons for such instability and suggests a method of correcting the problems.

FOCUSING ON THE SAMPLE LOOPS

Current sampling loops are normally installed at or near the point of maximum current *(the current loop)* on a tower. For ninety degree or shorter towers, the current loop is at or near the bottom of the tower. The loop is normally installed approximately twenty to twenty-five feet above ground level for towers of this height to minimize the effects of currents flowing in the ground system.

A Typical Sample Loop

For taller towers, such as towers within the range of approximately 110 to 225 electrical degrees, the loop will normally be installed approximately ninety electrical degrees (adjusted for the propagation velocity of the tower) below the top of the tower.

For our purposes, we assume the problem of an erratic ratio or phase indication has been narrowed to one or more sample loops and that the sample lines themselves have been exonerated from the causes.

Since the purpose of the sample loop is to extract a reliable and repeatable sample of the current flowing past the loop, the installation must be made impervious to any changes that can affect the accuracy of the sample. This statement also applies to the transmission line *system* that conducts the current sample to the antenna monitor.

THE LOOP ASSEMBLY

Figure 1 is a photograph of a widely used sample loop connector assembly that is used to connect a sample line having a type N or UHF female connector to the physical sample loop assembly. For brevity, the type N or UHF connector will be referred to as "the connector."

Figure 1 – The original sample loop connector assembly .

It is assumed that the sample loop operates at tower potential; that is, the sample loop and the interconnecting transmission line on the tower are electrically bonded to the tower structure. This is normally the case except in certain instances where corners have been cut when using electrically short towers, with the loops installed very near the ground. In this case the sample loop and the interconnecting transmission line are physically insulated from the tower structure.

The sample loop connector assembly is normally installed at the bottom of the loop with the assembly mounted on the grounded side of the loop (the side facing the tower). The insulated center conductor is connected to the "hot" side of the loop through a short section of one-half inch silver-plated copper strap.

The particular loop connector shown is a very well constructed unit based on a machined Teflon insulator assembly *(the "spark plug")* which houses a standard chassis mount connector and a short length of 6-32 brass all-thread soldered to the connector assembly which protrudes through the top of the insulator. The copper strap is physically captured between two nuts, a pair of flat washers and a lock washer. The grounded side of the loop is attached to the outer conductor of the connector through four 4-40 machine screws.

POTENTIAL TROUBLE AREAS

Two principal problems arise with this type of arrangement. The first is the security and integrity of the center conductor; the second is the integrity over time of the ground return between the loop and the connector.

The first problem is mostly mechanical in nature arising from the original installation or from trouble-shooting efforts or repairs in the field. The connector was never designed to withstand abnormal axial forces on the center conductor nor was it designed to accommodate rotation of the center conductor.

These situations arise when a tower rigger is entrusted to perform trouble shooting or diagnostic actions on the connector while it is installed on the tower. Riggers are trained to use (and are accustomed to using) tools very large in comparison to those used by technicians in radio stations and will frequently apply excessive torque to the nuts, which results in rotatation of the center conductor, or simply tighten the nuts until the center conductor is physically pulled out of the connector.

The second problem results from the long-term effects of electrolysis and from making an electrical connection through a dielectric material without appropriate hardware in the electrical path. The electrolysis problem arises from the dissimilar metals used in the coaxial connector and the loop itself. The problem is aggravated by the presence of the Teflon insulator in the mechanical path of the electrical ground return of the circuit.

Over a period of time, the aluminum surface of the loop will oxidize and will cause a small amount of direct current to flow through the dissimilar metals, typically nickel plated brass for the connector, stainless steel for the 4-40 screws and nuts and aluminum for the loop. No matter how tight the 4-40 screws are when they are installed, they will eventually loosen due to cold flowing of the Teflon insulator.

DISASSEMBLY AND CLEANING

The solution to the problems is relatively simple, but the loop(s) must be brought to the ground for repair and modification. The modifications can be made in approximately one hour by a skilled craftsman, provided the required materials are on hand.

Start by having the tower rigger mark the exact location and orientation of the loop with spray paint. This can be done by spraying a vertical stripe from about six inches above to six inches below the mounting brackets, which attach the loop to the tower. This should be done on both sides of the brackets to assure proper re-installation of the loop following completion of repairs.

Next, remove the connector assembly from the loop, being careful to avoid stressing the center conductor. Use a pair of small needle nose pliers or a narrow open-end wrench and a nutdriver to remove hardware securing the copper strap to the center conductor. Then remove the four 4-40 screws holding the assembly to the loop. Remove the nuts from the assembly and disassemble to connector assembly into its component parts as shown in Figure 2.

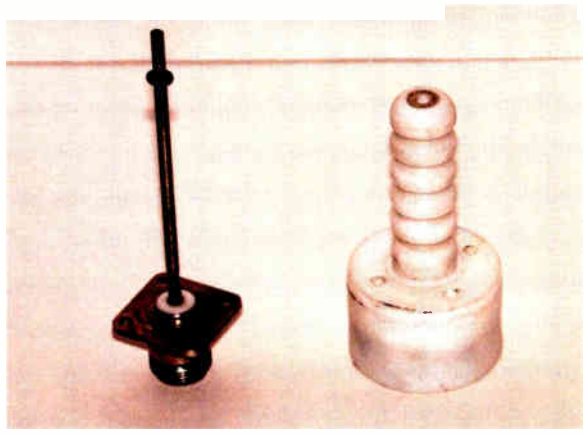

Figure 2 - Disassembled components from the connector assembly.

Carefully inspect the connector and the connection to the brass all-thread for physical and electrical integrity. If the center conductor is loose or the connection is broken, replace the connector with a new one. If both are in good condition, carefully clean both with acetone or another suitable cleaning agent to remove all vestiges of sealing putty, "Scotchkote" or other sealants, which may have been used to waterproof the installation.

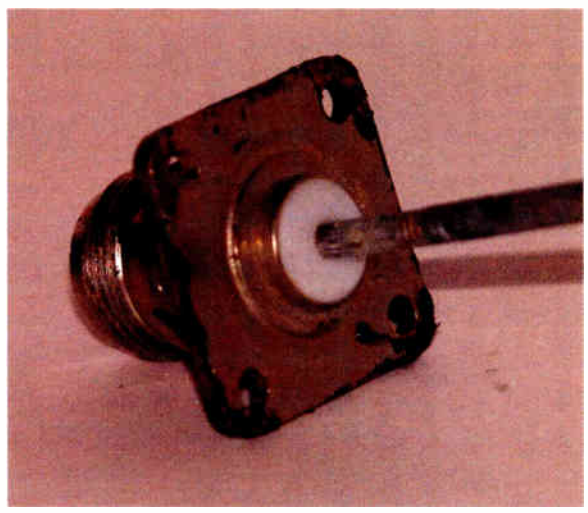

Figure 3 - Close up view of the connector.

PREPARATION

Install a 1/4-inch by 1/2-inch 6-32 nickel or zinc plated round brass spacer on the center conductor and set the end of the spacer to a depth of 1.15 inches from the rear surface of the connector. Using a suitable jig to maintain exact vertical and horizontal alignment and a drill press, carefully drill out the four #4 holes to 0.255 inches. This will provide sufficient clearance for the four spacers. Drill out the center hole to a depth of 1.15 inch from the flat surface of the teflon insulator which mates with the rear surface of the connector.

Carefully place the assembly shown in Figure 4 into the center of the insulator until the spacer seats in the insulator. Carefully rotate the connector until the rear surface rests against the flat surface of the insulator. Remove the connector assembly and place a drop

(Continued on Page 18)

MORE PRODUCTS... MORE APPLICATIONS

TT-1

The tiny TOOLS™ TT-1 is more than just an ordinary telephone line coupler. The TT-1 is a rack-able compact telephone line powered auto-answer and auto-disconnect hybrid. The TT-1 utilizes dual-hybrid transformers providing full duplex audio at a plain old coupler price. We provide a rear panel multi-turn hybrid NULL trimmer to allow the user to achieve 20 plus db separation figures. TT-1 features include: Front panel Line Seize button; call Drop button; Auto-Answer/TAP switch; Audio Mute switch; Off-Hook and Ring indicators. The rear panel is equipped with a RJ-11 jack for the telephone line and a second loop-thru RJ-11 that may be configured to disconnect attached devices when the TT-1 goes off-hook. Screw terminals are provided for balanced send and caller audio; remote optically isolated seize and drop functions and one SPDT off-hook dry relay contacts. The TT-1 may be set on a desktop, mounted on a wall or up to four units mounted on the RA-1, Rack-Able mounting shelf.

The TT-1 Telco Tool

The DTD-16 DTMF Tone Decoder

The tiny TOOLS™ DTD-16 is a full-featured DTMF tone/sequence decoder that is user programmable to decode up to six tone sequences or a single tone and assign it to any one of four relays, twelve open collectors and/or the RS-232 serial port. The relays/open collectors may be programmed to close for the duration of tone, pulse immediately after completion of detection, latch/unlatch or exclusive operation.

The DTE-16 DTMF Tone Encoder

The tiny TOOLS™ DTE-16 is a feature rich DTMF tone/sequence encoder that is user programmable to encode up to 15 tone sequences or a single tone via any one of 16 contact closure inputs and/or the RS-232 serial port. Each input may be programmed to generate a tone for the duration of the closure or tone burst immediately on command. A passive mixing network is provided to mix both the program and encoder audio if required.

The VAD-2

The tiny TOOLS™ VAD-2 is a user programmable two-input multi-number voice/pager auto dialer with integrated stereo silence sensor, designed for dial out paging and/or voice message notification. Two SPST relays are included for remote control functions.

The DC-8

The DC-8 Plus Dial-up Remote Control allows the user to control and monitor external devices from any touch-tone, telephone. The DC-8 Plus when called, will answer the phone line after a user programmable number of rings (up to 20), accept an access code (none to eight digits) and if valid, allow the control of six SPDT, two 2PDT relays and the monitoring of eight logic level status inputs. The DC-8 Plus is equipped with an adjustable audio hybrid, allowing the user to send and/or receive external audio, while controlling the unit

The STI-II

The STI II provides a hybrid interface between a single POTS line and a users PC COM port. The STI II is equipped with a programmable serial port, allowing control and monitoring via the users PC application software. This product makes those remote call-in recordings a snap while eliminating the DTMF tones. Various LED's, relays, pushbuttons, dipswitches and serial port comprises the user interface to the STI II.

The TS-6 Telephone 6 Six-Line Telephone Call Director

The TeleSwitch Six call director offers a low cost solution to interfacing up to six telephones lines to almost any hybrid. The TeleSwitch Six is supplied with one Switch Console and Controller. The units are interconnected via CAT 5 cable. A total of four Switch Consoles may be attached to the controller. The TeleSwitch Six is a dual-bass device, meaning that calls can be answered on the telephone set, while calls are active on the hybrid. With TeleSwitch Six, lines can be answered, placed on hold (MOH audio input), bussed out and routed to a telephone set and/or hybrid.

The STA III Smart Telephone Autocoupler III

The STA III provides the interface between telephone line and user equipment. The STA III provides a self-null hybrid with balanced input and outputs. The STA III monitors the telephone line for CPC calling party control and long dial tone hang up signals, allowing use behind PBX telephone switches and POTS lines

The AVR-8 Voice Remote Control

The AVR-8 is a voice remote control system that automatically reports changes detected on any of its eight status inputs to a remote telephone and/or pager. After speaking a greeting message that may identify the source of the call, the AVR-8 then speaks a unique message for each status input. The user may customize each factory-recorded message. Additional features include; four SPDT control relays, balanced telco audio, access codes, eight phone numbers per input.

The DEC-16

The DEC-16 may be used as a dial-up; dial-out or direct connect DTMF decoder. The DEC-16 is capable of automatically calling out, answering calls or connecting to an ENC-16, DTMF encoder or other DTMF encoder

The ENC-16

The ENC-16 may be used as a DTMF encoder, dial-up, dial-out or direct connect interface. It is capable of automatically calling and connecting to a DEC-16 either on a dial-up telephone line or a direct wire connection. There are 16 input lines. Each input can be used to generate DTMF tone strings from 1 to 16 digits long. The ENC-16 can operate as a master or slave device. Set as a master it will it will automatically establish a connection to its slave encoder. If the connection is lost, it will re-establish contact automatically. Contact closures and/or its RS-232 serial port may control the ENC-16.

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by J.S. Sellmeyer, P.E.

Continued from Page 16

of Locktite on the threads of the center conductor at the top of the spacer. Turn the spacer two turns counter clockwise to absorb the locktite, then turn the spacer two turns clockwise.

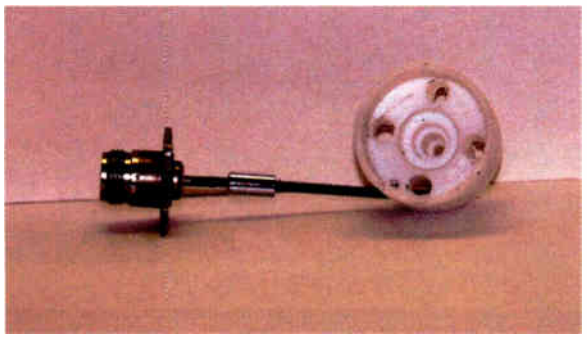


Figure 4 - The modified connector and insulator.

Next, tap each of the four holes in the connector with a 6-32 tap. Install four 6-32 x 3/8 inch stainless steel phillips pan head screws the connector mounting holes.

On the interior side of the connector install four split lock washers and four 1/4-inch by 1/2-inch spacers tapped for 6-32 hardware as shown in Figure 5.

REASSEMBLY

Now place a thin layer of silicon grease on the five spacers, then carefully reassemble the connector into the insulator. Place a thin layer of silicone grease on the top of the insulator and add a 1/8-inch by 1/4-inch neoprene "O" ring on the center conductor.

The silicone grease is necessary to prevent moisture from entering the interior portion of the connector assembly. Place a number 6 flat washer and a number 6 split lock washer on the center conductor. Install a 6-32 hex nut on the center conductor and carefully tighten it to slightly compress the "O" ring. Add a second 6-32 hex nut and carefully tighten it against the first nut.

Figure 5 - The connector with spacers in place.

Figure 6 - The completed assembly.

Apply a drop of Locktite to the center conductor and install a split lock washer and a 1/4-inch by 1/2-inch 6-32 threaded brass spacer on the center conductor. Carefully tighten it while holding the hex nuts with a pair of small needle nose pliers. The finished assembly should look like Figure 6.

LOOP CLEANUP AND RE-INSTALLATION

To get the loop ready, clean the top and bottom surfaces of the loop where the connector mounts to the frame. If necessary, drill out the four mounting holes to accommodate the 6-32 screws.

Place a drop of Locktite on the tip of each of four 3/8-inch-long 6-32 phillips pan-head screws, add a split lock washer to each and install the connector on the loop frame. Securely tighten the screws.

Connect the copper strap from the "hot" end of the loop to the brass spacer with another set of 6-32 hardware. Add a drop of Locktite to the end of the screw and tighten it while holding the spacer in a pair of pliers to avoid stressing the inner conductor.

The connector modifications are now complete and we are ready to have the rigger carefully reinstall the loop on the tower. The result should be a solid connection to the sample loop, and steady, consistent phase and ratio data.

Once the system has been cleaned, inspected and reinstalled, it is very important to routinely log the phase and ratio readings from the antenna monitor together with the prevailing weather conditions such as temperature, ground moisture and wind conditions.

This data should be taken at least once per month along with the monitor point values. Such a log will enable the technician to accurately isolate and diagnose problems with the antenna system and its associated antenna monitoring system.

President of Sellmeyer Engineering in McKinney, Texas, Jack Sellmeyer has designed, constructed and maintained many directional antennas over the years. Jack Sellmeyer can be contacted at his email address: jack@sellmeyerengineering.com

Full Duplex

by George Nicholas

Have I Got a Deal for You!

[CEDAR RAPIDS, Iowa] "Gather around, folks! I've got something to tell you! And, I've got something to sell you!" Interested? Read on ...

Okay, let us dispense with the circus "Carney" act and dive right in to this month's Full Duplex. It is all about selling. After all, in our business, sales solves everything, right?

ENGINEERING IS SELLING

Well, mostly. After reading Jeffrey Gitomer's *Little Red Book of Selling*, I was stunned by the parallels between successful sellers and engineers.

See if you agree with me. Here are the 18.5 Secrets of Success, according to Mr. Gitomer, along with our comments:

1) *Believe you can.* A positive mental attitude is key to fixing something you have never fixed before.

2) *Create the environment.* Surround yourself with family, friends and co-workers who support what you do.

3) *Have the right association.* Related to #2, hang around with successful people – and stay away from poison people.

4) *Expose yourself to what is new.* If you are not learning every day, your competition is.

5) *Plan for the day.* It has been a while since we discussed "the plan." [**Radio Guide** - April 2003] How is yours coming along? Keep your daily plans (and goals) in front of you all day long.

6) *Become valuable.* This where a lot of engineers get stuck. Do not be *just* the engineer, be the go-to or resource at your station. If your skills are not where they need to be, then exhibit a willingness to help others anyway. That is more valuable than you think!

7) *Have the answers your prospects and customers need.* Substitute "prospects" with "managers" and "customers" with "co-workers." Remember, you are an engineer, which usually means nobody understands what you do. Do not provide facts – instead, provide answers!

8) *Recognize opportunity.* This is another way of saying, be proactive.

9) *Take advantage of opportunity.* First, recognize it – sometimes it shows up disguised in the form of adversity! Then, act on it.

10) *Take responsibility.* We all blame others to a degree. Blame is tied to success in reverse proportion. If you have made a mistake, accept the majority of the blame and move on.

11) *Take action.* Nothing happens until you do something to make it happen.

12) *Make mistakes.* Yep, that what I said. The best teacher is failure. But do not think of them as mistakes – think of them as learning experiences not to be repeated! (Exception to this rule: *do NOT* stick your hand in the transmitter; you may not get a second chance!)

13) *Willing to risk.* Risk is not always dangerous! Rather, it should be the basis of your success. In other words, you will never reach your goals without going beyond your comfort level.

14) *Keep your eye on the prize.* Post your goals and stay focused. The goals do not have to be engineering, either. Losing 20 pounds, spending more time with family and friends, even walking the dog more are just as important.

15) *Balance yourself.* Your physical, spiritual and emotional health are vital to your success.

16) *Invest, don't spend.* The author suggests a 10-20% gap between earning and spending. Invest in yourself each month.

17) *Stick at it until you win.* Many give up too soon. Do not quit on the 10 yard line. Your plan and commitment should see the plan through, no matter what.

18) *Develop and maintain a positive attitude.* A positive attitude makes achieving success much easier and more fun.

18.5) *Ignore idiots and zealots.* There are always people that will try to bring you down, because they have no options of their own. Avoid these people at all costs.

THINK, THEN ACT

Whether you do some, or all of the ideas above, I believe these are some great thought-starters. Think of some of the successful people you know, in any business, and I bet they practice most of these ideas.

The other parallel between sales and engineering is, as engineers, we are always trying to "sell" ideas and procedures to others at the station. For example, it may be trying to convince the GM or regional engineering manager you need a new console.

People do not like to be sold, but they love to buy. As a seller, you have to package the product in a way that it is attractive to the buyer. Here is a true story that involves an engineer (me) about ten years ago.

A GOOD DEAL

I was contracting for a station, whose manager I did not consider "spendy." We often had discussions about small expenses, and frankly I was growing tired of the battle. Then one day he approached me about building a new station for him. I figured, "what the heck, I can put together a list of good equipment, and he probably won't go for it anyway. But it'll be a good lesson in doing a budget."

To my surprise, he agreed with most, if not all, of my selections. I asked why he was so willing to spend money, when traditionally he would decline. His surprising response: "George, I'm not as concerned about the cost as I am about 'the deal.' If you show me I'm getting a good deal, I'll always take advantage of that. But if it's a bad deal, I'll walk away, no matter what the price."

Too bad I did not know that two years before! And you can bet from then on I always provided details of how great the deal was for him. Since most managers come from sales, "the deal" really is important to them. Keep that in mind, as you *sell* them.

George Nicholas specializes in technical and communications consulting throughout the US. If you have an idea to share, email him at: georgenicholas@csi.com

Transmission Guide

by Barry McLarnon, P.E.

FM Coverage in the IBOC Era

As the rollout of digital transmitters continues, more and more stations are beginning to find IBOC signals on their doorstep. Here, Barry McLarnon begins an analysis of what sorts of effects both AM and FM stations can expect to impact their digital and analog coverage.

[OTTAWA, Ontario, Canada] In broadcasting, interference is dealt with by means of protection ratios.

PROTECTION RATIOS

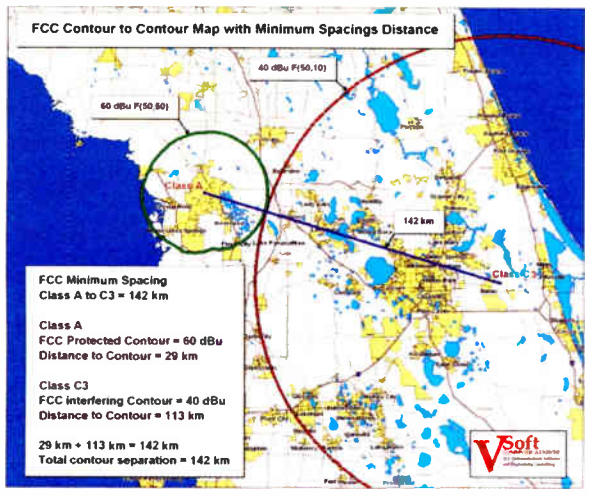
Every station that is afforded protection under FCC Regulations has a protected contour (54 dBu for Class B, 57 dBu for Class B1, and 60 dBu for all others), and it is along this imaginary line where limits are set on the field strengths that can be received from co-channel and adjacent channel stations. These limits are expressed in terms of D/U (Desired-to-Undesired) power ratios that, on a statistical basis, should nearly always be exceeded inside the protected contour.

For the FM service in the USA, the prescribed D/U ratios for commercial stations are 20 dB for co-channel stations, 6 dB for first adjacents, and -40 dB for second and third adjacents.

For non-commercial stations, the ratios are the same, except for second-adjacents, where the minimum D/U is -20 dB instead of -40 dB. The ratios for non-commercial stations also apply to coordination with Canada and Mexico for all FM stations within a certain distance of the border.

PROTECTION BY SPACING

In practice (since the FCC Rule changes in 1962), FM allocations for commercial stations are based upon a simplified procedure that sets out minimum distances between stations for various classes and channel relationships.



A Typical FM channel study showing spacing contours.
Courtesy of V-Soft, www.v-soft.com

The protection ratios normally become a factor only when "short-spaced" allocations are proposed, and an engineering study must be done to show that the ratios will be respected. However, the minimum spacings were developed with these ratios in mind, so the ratios presumably are indicative of the maximum interference levels that most stations can expect at their protected contours (with some notable exceptions, as we shall mention later).

Now we pose some questions: where did these numbers come from, and do they accomplish the goal of providing a known coverage area that is unimpaired by interference? And what happens when we throw IBOC (In Band, On Channel) digital transmission into the mix?

MODERN TRANSMISSION, OLDER STANDARDS

The answer to the first question is quite simple. The D/U ratios were based upon the results of tests conducted by the FCC on FM broadcast receivers in 1947. The protection ratios that were based upon these studies were adopted in 1949. Prior to 1949, there were no Rules regarding protection from second and third adjacent channel stations. This led to a number of allocations before that time that continue to be problematic today.

This is especially true in the case of super power and short-spaced facilities.

On the other hand, the answers to the other two questions are anything but simple! In the nearly 60 years since these tests were done, broadcast technology has marched on, especially on the receiver side.

In 1947, all FM receivers used vacuum tubes and LC filters, and were designed for fixed service and monophonic audio reproduction. It is unlikely that there was a great deal of variation in the characteristics of commercial receivers in 1947, but today, there is a huge range of quality and performance available.

And if we could compare those 1947 models with a broad sampling of today's receivers, I have the uneasy feeling that those older receivers would fall into the upper end of the performance scale (for fixed monophonic reception). Obviously, one can build a better receiver with today's solid state technology, but it does not necessarily follow that all current receivers *are* better, especially with regard to dealing with interference. One thing should be clear: if you want to characterize the impact of interference on coverage in the FM band, the receiver used *must* be part of the equation.

QUANTIFYING INTERFERENCE

Interference is in the eye of the beholder, and different people will have differing levels of tolerance for various types of impairments to an audio program. With modern techniques for signal processing and compression, impairments have become increasingly subtle, necessitating the use of well-designed subjective testing methods to assess their impact.

Interference, however, is typically less than subtle, and it is possible to get a good handle on it by means of objective measurements. This involves measurement of the audio signal-to-noise ratio (SNR), and the standard method for conducting these tests is set out in ITU-R Recommendation 641.

In order to provide a better correlation with subjective test results, the SNR measurement is done in a special way that more closely approximates the response of the human ear, called the Weighted Quasi-Peak (WQP) method. Unless otherwise specified, all references to SNR here will refer to WQP measurements.

The test methodology is quite simple: the unimpaired SNR is measured, and then the interfering signal is introduced at a low level, and increased in small steps until an impairment criterion is met.

There are two possibilities for this criterion: If the initial SNR was 55 dB or more, then the criterion is met when the SNR drops to 50 dB. On the other hand, if the initial SNR was less than 55 dB, then the criterion is met when the SNR drops by 5 dB. In either case, the final result is the D/U ratio at which the criterion is met.

REAL WORLD DATA

The ITU-R procedure basically estimates the D/U ratio at the *onset* of interference, when the interference becomes noticeable to most listeners, but probably not greatly annoying. There is quite a bit of data available for FM receivers obtained by this procedure, when subjected to interference from co-channel and adjacent channel interference from FM signals.

We have LPFM to thank for most of this data, as the debate over its merits sparked a flurry of FM receiver tests in 1999. These tests revealed that a great many of today's FM receivers are not adequately protected by the allocation rules that were crafted nearly 60 years ago (and subsequently watered down in some respects). FM coverage has become a complex issue that is highly dependent on receiver performance, and it is now becoming even more complex with the introduction of hybrid IBOC emissions to the band.

In contrast to FM in general, when it comes to interference from IBOC signals, we have only the test data from iBiquity to work with, and they did not use the ITU-R procedure in their tests.

IBOC TEST DATA

Instead, they set up interference situations at a number of fixed D/U ratios, and measured the resulting SNR. This is also a valid approach, and it can be quite revealing, providing that a suitable range and number of D/U ratios is selected.

Subjective audio tests using panels of listeners were also conducted by iBiquity, and the results compared with the objective SNR measurements. The comparisons confirmed that there was generally good correlation between the two approaches. In particular, they defined the concept of a "tune-out threshold," where 50% of listeners would find the interference objectionable enough that they would stop listening to the desired station. It was found that this threshold corresponded to an SNR of about 30 dB.

A major weakness of the iBiquity receiver test program is the small number of receivers actually tested. Tests were done on only four receivers: a Delphi OEM car receiver, a Pioneer aftermarket car receiver, a Technics home "hi-fi" component receiver, and a Sony "boombox"-type portable. To make matters worse, the two car receivers were much the same in terms of performance, so there were effectively only three receivers tested.

By way of comparison, consider the report on FM receiver interference tests produced by the FCC in connection with the LPFM debate (filed on MM Docket 99-25 in 1999). That report disclosed test results for 21 receivers, and its concluding remarks included this statement: "Caution must be exercised in extending sweeping conclusions from the data to the general population of receivers due to the small sample size."

If a sample size of 21 is small, then a sample size of 4 can only be considered minuscule. How is it then, that a few years later this same FCC was willing to accept the assurances of the NRSC that IBOC interference problems would be minimal, based on such a tiny sample? I leave that as a rhetorical question for the reader to ponder.

Despite their obvious shortcomings, the iBiquity test results contain some useful findings. There is enough, at least, to provide a glimpse of how the FM band landscape will evolve as IBOC is deployed in increasing numbers.

CO-CHANNEL INTERFERENCE

You might think that all FM receivers would have similar susceptibility to co-channel interference, but this is not the case.

A good source of data on this is the measurements performed on 28 receivers of various types, commissioned by the NAB in 1999. The tests were done at three different desired signal levels; we will focus on those done at the lowest level of -65 dBm, which roughly corresponds to the signal level received at a station's 60 dBu contour, if the receiving antenna is 1.5 m above the ground.

Some of the low-end receivers performed very poorly at this signal level, but it is the best one for comparison with the results of the iBiquity tests, which were done with desired signal levels of either -62 dBm or -77 dBm. The co-channel D/U ratio where interference became noticeable (by the ITU-R criterion) ranged from 9 dB to 46.5 dB, with a median value of 34 dB.

For the majority of these receivers, interference at the FCC co-channel protection level of 20 dB D/U would thus be noticeable, and possibly quite annoying. In contrast to the FCC rules, the ITU-R guidelines for co-channel FM protection ratios are 36 dB and 45 dB for mono and stereo, respectively. This seems much more in keeping with actual receiver performance.

IBOC OR IBAC

Now, suppose we add IBOC to a co-channel interfering signal – will this make matters worse? As we all know by now, IBOC is really IBAC (adjacent channel), so the short answer is no.

If we have a co-channel D/U ratio of 20 dB with the analog interfering signal, then the D/U with respect to each of its digital sidebands is 43 dB. Even the worst receivers are unlikely to have a problem with a first adjacent signal that is that far down.

But there is one special case that we do have to take note of: digital sidebands on the desired station itself, if it runs IBOC.

(Continued on Page 22)

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- Randy Mullinax
(Tyler Broadcasting, Oklahoma City)

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Tieline® TECHNOLOGY

Transmission Guide

by Barry McLarnon, P.E.

Continued From Page 20

In this case, we have two first-adjacent interfering signals, each at a D/U ratio of 23 dB, and this ratio is the same, on average, throughout the station's coverage area (there will, however, be significant departures from this D/U in some locations, especially if separate antennas are used for the analog and digital transmitters).

DEMOD PROBLEM

Digital sidebands on the host station would not be a problem if it were not for a weakness in the design of the stereo demodulator used in many FM receivers. In these receivers, demodulation typically takes place in an IC containing a product detector that is driven by a 38 kHz square wave, which in turn comes from a digital PLL that is locked to the 19 kHz pilot tone.

Since the reference signal is a square wave, the detector responds not only to the stereo information located around 38 kHz, but also to any signals within the same range (±15 kHz) of odd multiples of 38 kHz, i.e., 114 kHz and 190 kHz. For example, a CW signal at 115 kHz from the FM carrier frequency can produce a 1 kHz tone in the demodulated stereo signal.

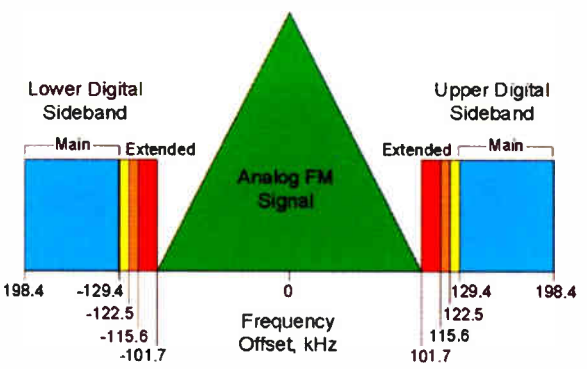
This signal can be attenuated by IF filtering before it reaches the demodulator, but most receivers do not have much rejection that close to the tuned carrier frequency. Another option would be to switch to mono reception, but most receivers do not provide a means of doing that manually.

Because of this problem, the designers of the hybrid FM IBOC system avoided the first region of susceptibility by locating the digital sidebands between 129 kHz and 198 kHz from the carrier. This is a safe distance from 114 kHz, but it means the digital signals between 175 kHz and 198 kHz from the carrier (i.e., within 15 kHz of 190 kHz) will get translated into audio noise by the stereo demodulator. The level of the noise depends on the quality of the IF filtering in the receiver.

REAL WORLD RESULTS

In the iBiquity tests, the two car receivers turned out not to have susceptible demodulator designs, but the other two receivers did exhibit the problem. When the digital sidebands were turned on, the SNR of the Sony receiver dropped a whopping 15.5 dB, to 35.4 dB. The SNR of the Technics receiver dropped 9.4 dB, to 49.2 dB.

The SNR of the Sony unit gets uncomfortably close to the "tune-out" threshold, and the background hiss should be quite noticeable whenever it is not masked by music programming. For both receivers, and others with similar designs, the effect of IBOC on the host station is to raise the noise floor significantly, and make the receiver more vulnerable to other impairments.



Digital FM +/-200 kHz from assigned frequency.

And guess what – it is going to get worse! The IBOC system specification includes several "extended hybrid" modes, which provide higher digital bit rates than the standard hybrid mode that is currently in use. This is done by adding new digital carriers below 129 kHz from the analog carrier, which is the region that is most problematic for receivers with susceptible demodulators.

There are three extended modes that use progressively larger chunks of the spectrum in this region. The three modes provide data rates of 12.5, 25, and 50 kb/s, respectively, in addition to the data rate of about 98 kb/s provided by the basic hybrid system. NPR has already begun lobbying the FCC to permit the extended modes, which are seen as a means of carrying reading services and the like, currently carried by FM subcarrier systems. The attraction of a boost in data rate of up to 50% will no doubt prove to be irresistible to other broadcasters as well.

NPR has done some measurements in which a comparison is made between the hybrid mode and one of the extended modes (the middle one of the three), in terms of the SNR of receivers tuned to the analog signal. None of the car or component receivers (three of each were tested) showed any significant change, but the four portable receivers tested all showed some further degradation in SNR when the IBOC mode was changed to the extended mode.

WHAT IT ALL MEANS

The worst case was a Sony portable, whose SNR dropped by about 6 dB. Unfortunately, none of the receivers tested were the same models as those previously tested by iBiquity, and no results were provided for the SNR with IBOC turned off, so it is difficult to make a comparison with the earlier results (and to make it even more difficult, they failed to use the standard WQP method for measuring SNR).

The bottom line, however, is clear: the extended hybrid mode will cause further degradation to the SNR of susceptible receivers, and perhaps even push some of them over the edge into "tune-out" territory.

With all this in mind, remember the digital sidebands from IBOC transmission will cross over into the adjacent channels, both first and second adjacent. What effect will digital transmitters have on their neighbors? We will analyze this together next month.

Barry McLarnon (VE3JF) holds a BS in Physics and MS in Electrical Engineering. He is a consulting engineer specializing in communications systems engineering. Mr. McLarnon has authored more than thirty technical papers and conference presentations related to radio communications engineering.

The Worst I've Ever Seen

A periodic display of the good, the bad, and the hard to believe.

In many places, spring has sprung. As the remains of winter fade away, and are replaced with growing green (and other colored) things, this is a good time to check the tower site for winter damage.

Of course, there is a whole list of things that ought to be checked, from the fences to the ground system. And there are those leafy things that can grow rather quickly in places you would prefer they did not.

Andy Soule shares this picture to remind us to do a thorough check, lest the guy wires and anchors find themselves too close to the foliage. Without proper remediation, branch and root growth could lead to the loss of a tower.

Remember, a well maintained tower site will prevent a lot of unpleasant surprises.

Radio Web Sites

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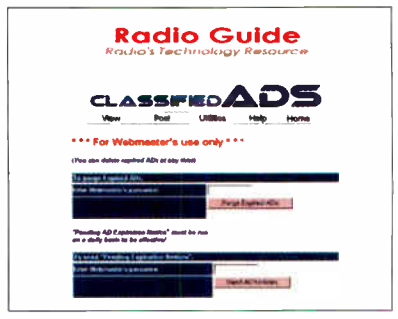

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Maintenance Guide

by Gary Minker

Line Sweeping

Part 4: Selecting a Line Sweeper

We continue our series on Line Sweeping with some helpful information on how to find and choose a line sweeper

[LAKE WORTH, Florida] Today is the day. You realize you need to employ the services of a Line Sweeping diagnostic professional. Now that you have crossed that line of indecision, you are faced with the task of selecting the right person for the job.

Sure, you can run to the factory of your choice (probably the manufacturer of your particular system, provided that you bought the entire thing from the same company) or you can go the third party route. There is merit in both choices. Let's talk about the pros and cons.

LOCATING A LINE SWEEPER

This is a terrifying and wondrous thing. If you have a monolithic system such as all Brand "D" antennae components and Brand "D" line as opposed to a Hatfield and McCoy set up, you can certainly call that provider.

They should have a ready trained group of people who either work directly for them in the plant and look at these things every day (and eat them for lunch and dinner), or they should employ predictably reliable independent contractors that are just as familiar with the products that the manufacturer builds, but have the advantage of seeing the *real world* failures and successes.

The advantages of the factory personnel are that many of the little nuances of the assembly and R&D issues are often tightly held and such information rarely gets circulated out to the field. Little things like the understandings of manufacturing glitches, tuning or slugging of components, assembly and re-assembly (which is important during a re-hab), test range behaviors and other esoteric issues are sometimes distant to the outsiders.

The advantages of having outside contractors who are groomed and supported by a particular factory include the advantage of their having seen the products in actual use – including (fortunately or unfortunately) in their failure modes. The latter is a scenario that factory personnel rarely get to experience. In essence, there is no clear-cut reason to give your favorite factory a call.

On the other hand, as the good book of knowledge says, you can call your "factory familiar and often relationship related" independent Line Sweeping professional contractor. These independents are often well equipped with the latest and greatest test equipment because they like to present themselves and their abilities as on a par with the factory folks.

You have heard it said that the underdog has to be better than ordinary because the market requires this for recognition. Sure, it is true that in some cases the factory guy might literally get away with "antennacide" (no slander intended), while the independent is only as good as his last fix-it episode. While this may be an industry faux pas, it is human nature nonetheless.

FACTORING THE CHOICE

Like any other professional who yields to the term "practice," the Line Sweeper is a rare breed. Some climb, most do not. Some have an electronic background; others do not.

Here are some random issues to think about. Is your candidate *(not the company)* an Amateur Radio Operator – and if so, what Class? Does he come from an electronic background? Is he familiar with grounding techniques? Has he met Marconi? Has he ever worked a solder sucker, manual or electric? Is he mechanical? Is this a long-term career or his third retirement from the insurance business? How long has he been working with antennae or filters and transmission line? How many systems has he tuned up? How long has he been driving the piece of test apparatus that he brought? Does he keep referring to the manual and staring into the screen wondering what that little bump means?

Does he understand the forensics of line and system failures? Is he able to determine from the forensic data if the chicken or the egg caused your fire? Is he familiar with rigging and lifting? Does he climb? Will he suit up and go up in the elevator? Is he afraid of heights or the dark? Does he work well with the tower crew (if you have or need one).

I hope you get the picture here. Selecting the right guy is tough. If you are asking for factory assistance you should ask these questions and *not* accept the stock answer that "this is our guy, and you can just about take him or forget it." My first thought is to not just hang up quickly but run as fast as you can for the list of other competent folks in the business.

THE RIGHT TOOLS

While these are just the human aspect questions, you should also be asking what he uses to diagnose the deal with. Is it a big battery, capacitor and fast oscilloscope (for you olde timers), a bridge and tracking generator with separate TDR, or a smallish handheld device from a large Japanese manufacturer.

Or does he bring a real piece of test equipment called a Vector Network Analyzer. Yes sir, you have got to use the right words and ask the right questions or you are going to get whatever you are going to get. And it might not be pretty in the end

WHAT IT WILL COST

This is purely hearsay: I hear that the range of charges is a hodgepodge of costs, charges, percentages, burden fees, shipping and insurance numbers.

Your charges may include some or all of these little numbers: Daily rates run from $800 to $1,500 per day. Some have travel or mobilization charges from $200 to $500 per day to go and come from the barn.

Then sometimes there are extra per-man charges or add-ons of $300 to $700 per day. Expenses are often billed at the cost plus 15 to 20 percent. There is sometimes a Per Diem cost per guy. Shipping of test equipment is extra and sometimes there are insurance charges. And do not even think of what it takes to work out of country or off shore.

All work should include at least two copies of the work in a printed or electronic report. The report should include graphical print outs and a letter from your guy as to what went down and why it happened that way, along with a blessing of good health and long life – at least until he hits the door.

As I have said before, your Line Sweeper is the wedding photographer. He takes the pretty pictures and then the food fight starts.

GETTING GOOD DATA AND REPORT

One hopes that after the grilling and inquisition of the selection, your Line Sweeper will arrive and his performance will give you the confidence in his presentation that you desire.

It is important that he has a positive interaction with you and his dialog is tempered to your speed and level of understanding.

You deserve a satisfying experience. It is not a good sign if the answers to your questions do not make sense to you. It is equally a bad sign if, when problems arise, the sweeper is back to reading the manual of operations for the test apparatus or the source of a good many strange sounds begin emanating from the guy.

When your report arrives, the first thing to do is to check it carefully to make sure it is neat and orderly. Is it really *your* system and data? (Yes, I have seen that one!). Is there sufficient data in the printouts and in the letter to allow a subsequent Line Sweeper (or heaven forbid, the same guy) to come back and perform your testing again a year later?

Every report should include graphical data. Tabular data or endless columns of numbers are for the really retentive and do not give a good picture of the Return Loss of the system.

In all cases the printed graphs should be in Return Loss/dB, Time/Frequency Domain, and VSWR. In some cases you might be able to wangle a Smith or Polar chart from your Sweeper, too.

I know all of this sounds a bit like selecting your family physician, but in some respects, it really is the same thing. You need to develop a relationship that you are comfortable with and – unfortunately because people change – you need to be wary of future problems even with the same guy.

HOW GOOD IS GOOD?

When you analyze the data, the Line Sweeper should be able to help you put it all in the proper perspective so that you can use the data confidently. You need to be able to trust his judgment as to what is acceptable and what is not acceptable.

For example, in analyzing the VSWR report, the acceptable numbers can vary from FM to TV, but the answer is 1.05:1 is a wonderful number. Where VSWR comes into play, you have to remember that a 25-watt soldering iron in the right place will cause some significant damage if left to play long enough.

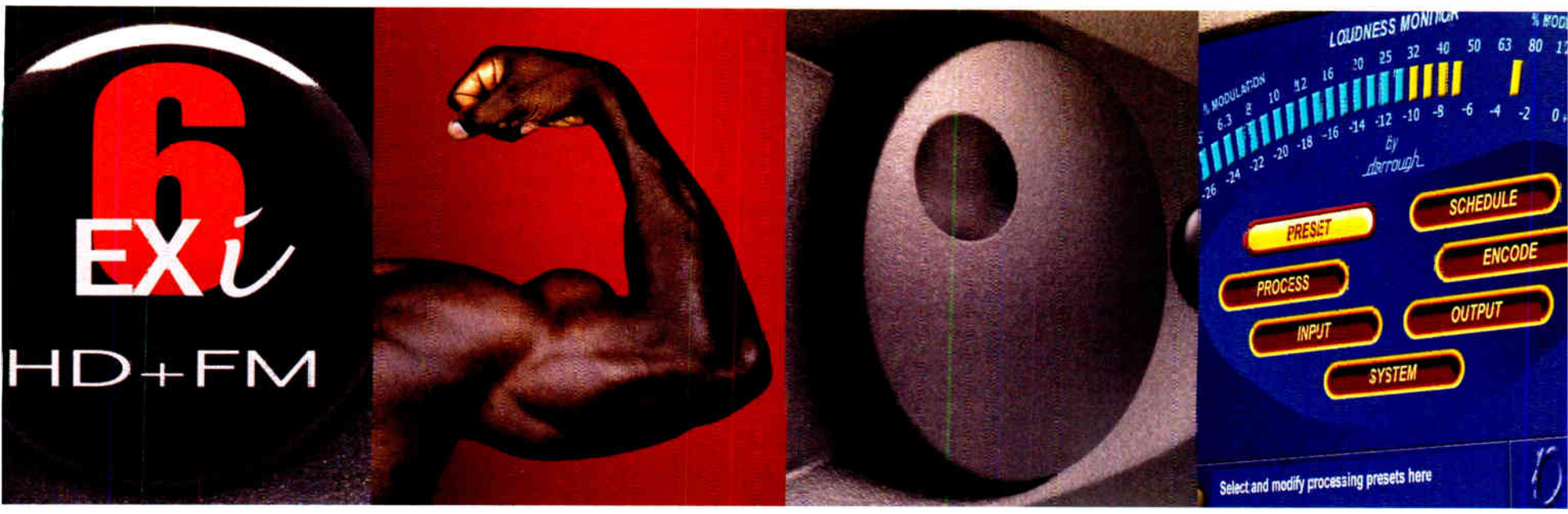
Take care, though. There is a wide range of opinions out there from the old school to the new, and in discrepancies from the analog theories to digital.

Here is some conventional wisdom from which you should draw a conclusion. Listen carefully, and question any statement you do not understand. Some very misleading things can be "tossed" at you. "Sure, anything that radiates 98% of the RF is great." "VSWR is not important in analog." "VSWR is not important in digital."

Why then, did SCSI cabling require a terminator for the end of line? Why then, did Lan/ThinNet require that neat little 50 Ohm precision termination at the end of the line? Why do the PCS industry construction specs require the 1.8 GHz systems to have an aggregate return loss of greater than 24dB and connector values in Time Domain of 30 dB or better?

Are you confused yet? Weigh all the answers and ask more questions. You will be glad that you did.

Owner of Radio Works R.F. Consulting in Lake Worth, FL, Gary Minker has analyzed hundreds of transmission systems. He can be contacted at gary@radioworksrfconsulting.com



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Site Guide

by Dave Maxson

Using the Proper Warning Signs

[MEDFORD, Massachusetts] "Lighten up, David, it's just a sign!" I get looks that seem to say this when I talk about RF safety signs.

Hard to tell if it is people or the sign that is in more danger.

After all, many people feel a safety sign is no different than a bumper sticker or a post-it on your cubicle wall. But it is not; it is very different. As an employer and a producer of RF energy, your company has an obligation to provide for worker and public safety in a structured manner.

KNOWING THE DANGERS

RF exposure fits in the Occupational Safety and Health Administration (OSHA)'s workplace hazard rubric just like any other risk. There is an expectation that a company will have a program to manage these hazards. There should be a written company policy; workers should be trained; and information should be presented in a uniform way.

The American National Standards Institute (ANSI) has a standard for hazard communication via signs. This provides a structured approach to signing a facility that is uniform across industries and hazards.

When you see an ANSI-compliant "Danger" sign, it should mean the same thing whether the hazard is RF, electrical, chemical, mechanical, or whatever. In ANSI parlance, the Danger sign goes at the specific point where there is an *imminent risk of serious injury or death.*

At RFSigns.com, we take this to heart. Our Danger sign is for those points in an RF facility where you could be *killed* by contact with or approaching an energized surface. The most obvious location is at the base of a series-fed AM tower.

THE ANSI SIGN

What makes an ANSI sign different from any old safety sign? There are several components: a **Signal Word**, a **Message Panel**, and a **Safety Symbol**.

Signal Words are placed in a corresponding color band across the top of the sign: Red = Danger, Orange = Warning, Yellow = Caution, Blue = Notice. There are some others.

The **Message Panel** has three pieces of information, where applicable: 1) the nature of the hazard (e.g. high levels of RF energy), 2) the consequence of the hazard (e.g. shock or burns) and 3) means to avoid injury (e.g. stay away, shut off power).

The **Safety Symbol** is any standard symbol used to illustrate a hazard. We tend to deal with two: RF energy, which we tend to associate with thermal exposure; and electrocution, which we associate with contact current, shocks or burns.

LAYERED ENVELOPES

I have created a concept I call *Maxson's Envelope Method.* If you think of your facility as containing layers of spaces progressing from the most hazardous (the innermost envelope) to the least (outermost envelope) you can determine how to sign it.

AM towers make good examples. A person can become the path to ground for very nasty amounts of energy at the base of an AM tower.

If there is a risk of electrocution at the base, mark it with Danger. The same applies for points of contact in the tuning unit or doghouse – exposed feed lines, tuning units and RF relays can be dangerous in ANSI terms. They all should have Danger signs.

This sign has all three components, and repeats the "danger" warning in Spanish.

If the danger is a point within a marked off area, then a Warning sign should go on the envelope that surrounds that area.

ANSI says "Warning" indicates "a Danger is inside." Rather than a risk of imminent serious injury or death (Danger), Warning simply indicates there is a risk of serious injury or death within the envelope. So post Warning signs on your AM tower fence and the outside of your ATU or doghouse if there is Danger inside.

NON-LETHAL HAZARD AREAS

What about non-lethal hazards?

An FM or TV tower site may not present an immediate opportunity for serious or lethal injury. Or there may be locations at an AM site that are off limits to the public or workers, without risk of serious injury. Here, we would utilize the Caution sign.

ANSI says "Caution" is for risk of minor injury. But what constitutes such a risk?

The way I interpret it is that there is no official point at which you are "slightly" injured by RF. However there are the familiar regulatory thresholds that the government says you should not cross – general public/uncontrolled exposure limits and occupational/controlled exposure limits.

Do you get injured crossing into non-compliant RF exposure fields? Usually not. But since you have to keep the public away from certain power densities and you have to keep workers away from certain higher power densities, it makes sense that these boundaries be respected with Caution signs.

PUBLIC SAFETY

So at an FM transmitter site, for example, there may be places from which the public should stay away. If so, mark the envelope (fence, door, etc.) with a public safety Caution sign.

If, inside that envelope, if there is an area that exceeds – or can exceed – occupational exposure limits, create an envelope for that area and mark it with an occupational Caution sign.

Similar Message and Symbol as the previous sign, but the Signal Word and color match a "Caution" condition.

Since this is an occupational threshold for trained personnel, it does not have to be a "*positive envelope*" such as a locked fence, door, or cage. It can be a *passive envelope* that consists of a rope or floor markings, and the Caution sign.

In some cases, it may be sufficient to post a Notice sign, which is informational and is not announcing a specific hazardous location, say on the door of the shack.

If routine or emergency repairs at a transmitter site could produce a temporary hazardous condition, such as an open live cabinet being serviced, or exposed conductors, then it is wise to identify a positive envelope inside which general public cannot go without an escort, whether it be a transmitter room or the entire shack.

Mark such an envelope with a public Caution sign.

ENHANCED SAFETY ZONES

Just to be sure, Caution, Warning or Danger areas that are temporary in nature still could be permanently marked and placed. For instance, even if your cabinet is interlocked, you might want to stick a Warning on the outside and a Danger on the inside in anticipation of a failed interlock or bleeder resistor, or of servicing conditions that expose normally secured spaces.

It generally makes sense to mark any tower for occupational exposure (Caution) at the climbing point, because the worker then is notified in advance that there are exposure issues to prepare for by consulting the site policy and/or site manager/attendant.

However, it can also be helpful on a busy tower to mark the points at which the Occupational envelope actually is located. This way, workers who may have specific systems with which they work on the tower will be informed of places where they should not go without exposure control.

THE SIGN

What about the proper size for a warning sign? ANSI has specifications for the proper letter size. For example, a message with one-inch lettering is assumed to be visible at 300 inches (25 feet). The Signal Word must be two inches high to be officially visible at that distance.

Of course, this leads to the natural question of "how many signs do we need to install? Simplistically, each 50-foot length of fence ought to be satisfied with a single sign with the lettering sizes just mentioned. (In certain areas, it might be advisable to augment this with signs in another, locally prevalent language.) Nevertheless, it is always wise to consider local regulations to reduce the potential liability

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David Maxson, CBRE, is the Managing Partner for Broadcast Signal Lab and RFSigns.com in Medford, Massachusetts. A member of the NRSC, he can be contacted at dmaxson@broadcastsignallab.com

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Field Guide

By Lyle Henry

SCA Wristwatches

[LOS ANGELES, California] It is quite possible some of you are wearing a watch that displays news, sports, stocks, weather, messages, and more.

Microsoft introduced this service as MSN Direct about a year ago in the top 100 markets covering most of the U.S. and Canadian population. Since I was one of the six installers, I would like to tell you about the project, and explain the equipment that may be in a rack at your station.

TWO SEPARATE ATTEMPTS

First, a little history to clear up any possible confusion. Seiko offered a somewhat similar service in a few markets in the late 1990s using SCA transmission to watches. Miniature technology was not so good at the time and it required a number of stations to serve each market.

Coverage was not great, mainly because of the receivers in the watches. Burt Weiner and I serviced the 17 stations here in Southern California. The Seiko service was turned off at the end of 1999.

Fortunately, much better technology was available to Microsoft. It was designed by Larry Karr at SCA Data Systems in Santa Monica. Basically, the system consists of a digital signal at 10% injection in the 67 kHz SCA channel combined with a scanning FM/SCA receiver in the watch, which locks onto any station carrying the MSN signal.

The equipment at each station connects with Redmond, WA. Conservative coverage maps and other information can be seen at http://direct.msn.com. Outdoors, I often found good coverage at up to twice the distances shown. The watches have the antenna in the wristband, a closed and reasonably resonant loop when worn on the arm.

SYSTEM PLANNING

Microsoft wisely hired Greg Jones of JComm Wireless in Aurora, Ontario as installation project chief. Greg is an incredible planner, organizer, and a coordinator with whom it was a pleasure to work.

My territory stretched from Wisconsin to Tennessee, South Carolina, and Maine, and most states inside that square, although there was overlap with other installers. Microsoft also had sent some of their people out to do a few of the early ones. I understood that Greg Jones as well as most of the other installers had worked for CUE Paging at one time. CUE had leased many 57 kHz SCAs around the country so some station engineers met certain installers for a second time.

There were several phases to the installation, which included VSAT or Frame Relay to Redmond, SCA Generators, and later, Monitors. As often happens with such projects, not everything could happen in the best sequential order so there were some return visits necessary. The whole project extended from Spring 2003 into Winter 2004. There were remarkably few actual problems, however, and most installs went smoothly and continued to operate well.

DUAL PATHWAYS

Redundancy was high on Microsoft's list, so typically two stations per market were used, with one fed by VSAT and the other by Frame Relay. Those installs were contracted to others. There were many stations owned by large groups, and if they had their own WAN, the Microsoft data was injected into it and a PIX was used to interface at individual stations. That kept the proprietary data of the station and MSN separate.

At each station, we installed an SCA Data Systems SCA generator and a monitor created by ADOT, a company I had not heard of previously. We connected them through a small Ethernet switch to the VSAT, Frame Relay, or PIX. The generator and monitor were each 1 RU and the VSAT or Frame Relay boxes were about 2 RU using the other gear as a shelf, so space requirements were minimal.

The SCA generators typically feed both main and backup exciters so we generally included a composite DA to split and adjust the level of the SCA signal. The monitors were usually able to pick up a clean enough signal off the air with a tiny antenna.

A Typical Installation

Each of us installers also had a beta watch with some neat stuff inside including an RF spectrum analyzer and a scope, which could display the data constellation, show approximate injection, and data quality/errors. This item always attracted interest and conversation!

To set injection, I used my set of four Belar digital monitors which included a tunable front end, Stereo Monitor, SCA Monitor, and The Wizard. An RF sample was usually taken from the transmission line. A directional coupler was used when a Bird or similar line section was in place.

HELPING OUT THE LOCAL STATION

I also had my HP spectrum analyzer along to look for any problems in the baseband and to show the engineers what our signal looked like since most did not have a spectrum analyzer available.

One station had an exciter that was oscillating at a supersonic frequency and creating trash. At another it was obvious that the composite STL signal was too weak. This was evidenced by a high noise floor; very noticeable in the upper baseband. The engineers were glad to know about these issues.

Spectrum display of the MSN signal.

The Microsoft digital SCA signal is quite flat topped and straight sided when viewed on a spectrum analyzer. It is about 17 kHz wide and does not overlap with the RDS or 92 kHz SCA spectrum. It is centered at a derived frequency just above 67.5 kHz.

LOOKING AT THE SIGNAL

Digital signals usually have a peak value which is somewhat higher than their RMS depending on the modulation scheme and how tight the filters are. This can be called the crest factor. For this system, it is 3 dB. Such peaks contain little energy. The FCC defines a peak as 10 cycles of a 10 kHz sine wave. This is 1 millisecond. And it appears that one can have up to five such peaks within 5 milliseconds.

Traditional modulation monitors react much quicker than that. Eric Small brought out the first modulation monitor to take advantage of the FCC definition. It is the famous Modulation Sciences ModMinder. The Belar Wizard is capable of similar performance, although they may arrive at the result in a somewhat different manner.

The process is called peak weighting and should be employed so that the whispy, low energy peaks of a digital SCA are ignored. Some other short duration modulation peaks may be ignored as well, permitting higher total modulation. To be conservative, I made my measurements with 9 cycle peak weighting, although the monitors permit up to 45 cycle weighting. This still provides a 5 cycle margin in FCC terms, depending on how one reads the Rules.

Measuring the SCA Signal

Probably everyone reading this knows that the total modulation can be increased by 1/2 of the SCA injection up to a total of 110%. For a 10% SCA, this means a total of 105% and turning down the main channel by 5%. But using The Wizard with weighting engaged, I found that probably half of the stations were able to add the Microsoft SCA without turning down the main channel program at all, and a couple where it could be turned *up*!

Being a small guy, I chose to drive my car to all the venues rather than take planes, deal with bulky equipment cases and rental cars. Since the work was not continuous throughout the install period, I decided to base at mom and dad's place near Green Bay, WI.

FAMILY BENEFIT

Now this was not exactly the wayward son moving back home since they were both in their 90's, had moved to an assisted living facility nearby, and were glad to have someone look after the house. So I got to see them for at least one meal every day, visit, play games, bring them back to their home a few times (always rather sad), take them to see friends or just go out for a drive. It also gave me a chance to see some old high school friends and visit my first radio station, WDOR in Sturgeon Bay, WI where I lived for 11 years.

The entire project was fun and exciting – even when experiencing 35 below zero temperatures in Burlington, VT (amazingly, my California car started the next morning!). But what was really special was meeting the great engineers at all the stations Microsoft had arranged to use.

While I hope I properly thanked each one at the time, and some were able to do lunch with me, the main thing was how kind, helpful, and courteous they were.

I know some engineers were not initially happy about adding a subcarrier to their signal, but it had been arranged by higher management. So there were the old worries about annoying birdies in the main channel, particularly under multipath conditions. However, I think everyone was pleased by the non-effect of the digital SCA. I certainly could never tell that it was there, as I listened to the stations for many miles before and after installation.

Based in Los Angeles, Lyle Henry specializes in SCA issues. The Radio Doctor can be contacted at: lylehenry@fastmail.fm

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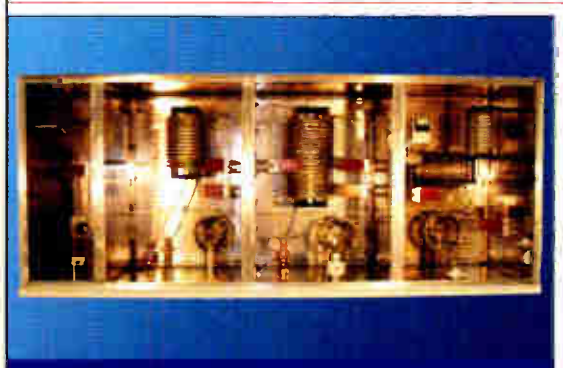

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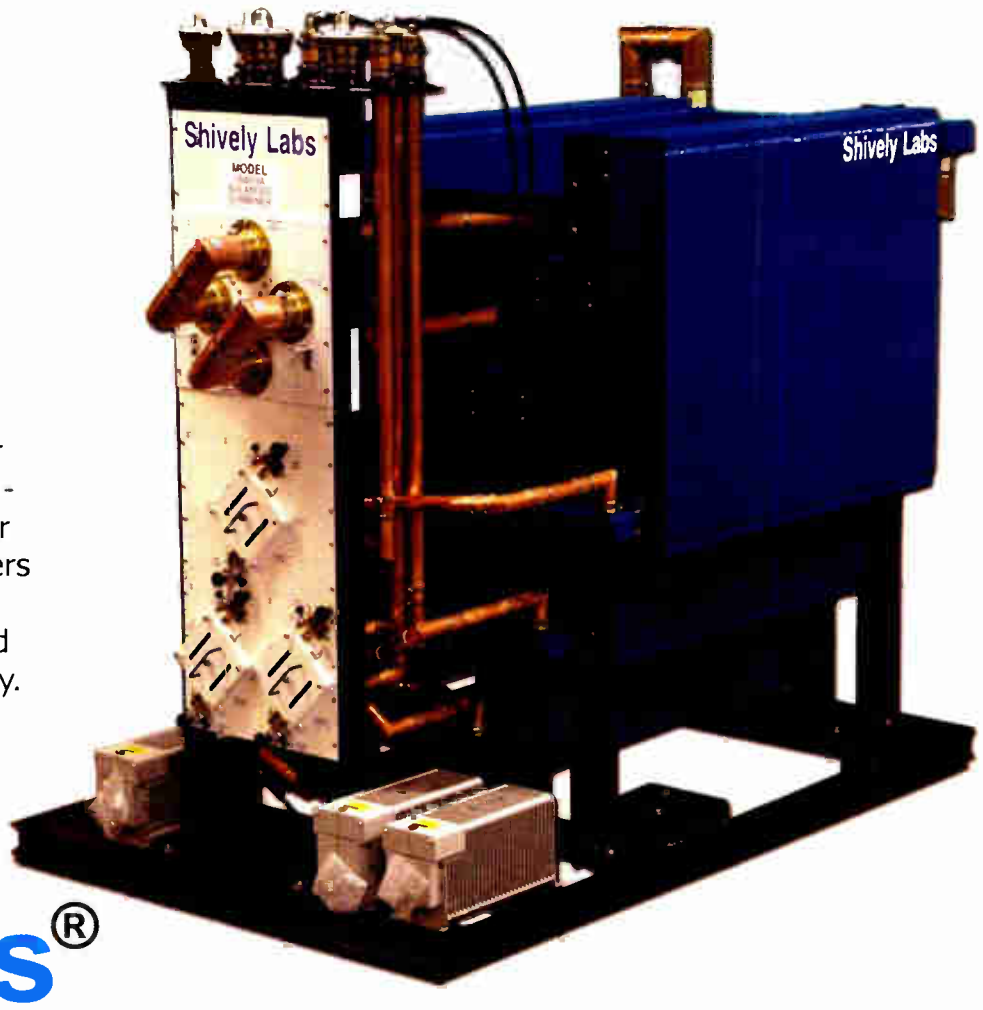

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Radio War Stories

by Bob Seaberg

Raising 480 Feet of Tower – in 15 Minutes!

[WHEATON, Illinois] It was September 1963, and the engineering project in front of us in Pifo, Equador was to erect an antenna array for short-wave transmission in 9 and 11 MHz bands.

The engineering design called for four towers to be erected supporting eight "lazy H" dipole arrays. (Four of these arrays would be the driven element and the other four serving as reflectors.)

HCJB engineering had heard of a unique method used by the U.S.Army for quickly erecting a 100' tower by pulling down a smaller tower. This had some merit for quickly raising a tower but it did mean that one wound up with half a tower on the ground. Not a problem as there was always a need for additional tower sections at that time.

But wait – there was a problem! The second tower was to be located 30 feet away and guy wires would not allow this method to be used for the second tower. Would it be reasonable to erect two 240-foot towers at the same time?

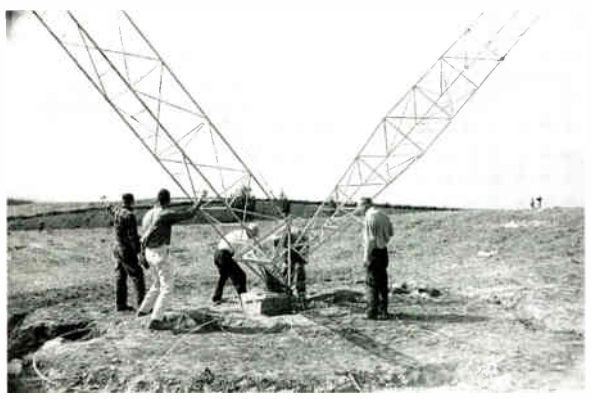
TESTING THE CONCEPT

Engineering stress studies indicated it looked feasible so we constructed a twelve-foot model to see what sort of problems, like pull-up points, stress on tower, guy wire location during the actual pull-up, etc., might be anticipated.

Since HCJB is a missionary facility, prayer seeking Divine Guidance is always a top priority. The directive seemed to be "go for it" and construction was begun.

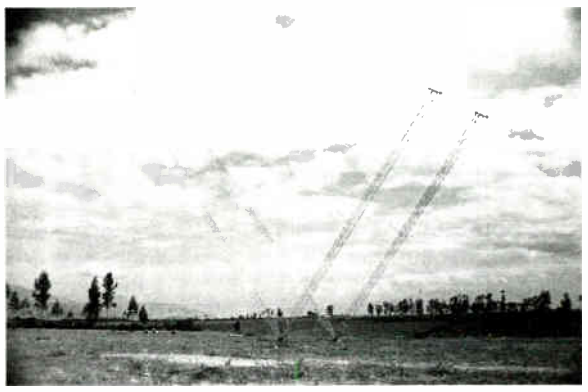
Getting ready for the erection. The shorter towers are vertical, the 240 foot sticks are laying on the ground. (The author is just left of the left tower.)

A unique part of this tower erection method is the "L" shaped base, which is attached to the 120' pull-down tower. It swivels on temporary ground mounted "hinges," positioning the taper base of the permanent 240' tower inches above the bolts imbedded in the concrete base.



The process of pulling the towers up is under way.

Jacking down the tower and securing it with washers and nuts was the next step. Tower alignment and guy-wire-tensioning adjustments were made and finally, after a second inspection check, the pull-up and restraint cables were removed.



Almost there. The leverage from the smaller towers helps pull the 240 foot towers into place.

EASY DOES IT!

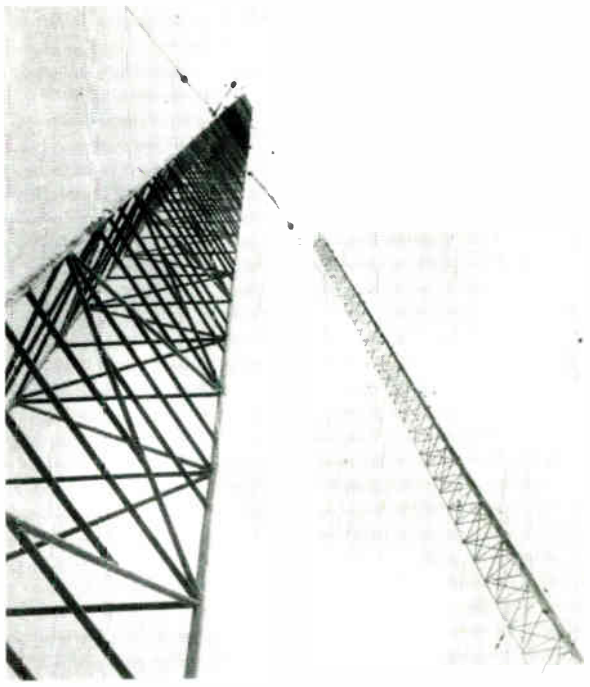
Need I say that very careful attention must be given to the guy-wires as the tower is erected? We used a four-wheel-drive truck as the pull-up mechanism and a pick-up truck loaded with stone for the restraint mechanism as the tower approached its vertical position.

Our Ecuadorian crew did a great job of paying attention to instructions. No major problems, no one hurt, and a unique engineering feat accomplished. Gracias a Dios!

REPEAT PERFORMANCE

Two weeks later the process was repeated as the engineering crew erected the other two towers for the actual radiating or reflector antenna elements supported by the four towers.

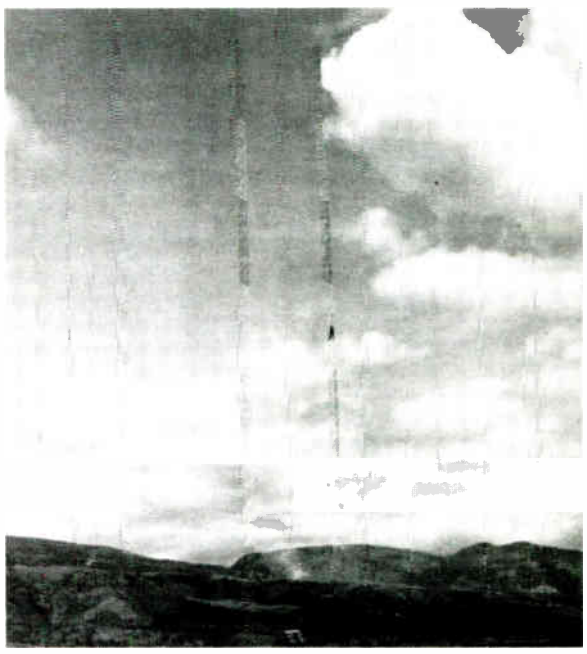
The towers are up and in place!



Ready for Programming

Using rather large relays located in a "bird house," the system was able to transfer power to the selected driven elements. Directional gain to Europe or the South Pacific was thus obtained.

If memory serves me correctly, one antenna change-over time was 11:30 PM (EST) when it became dawn over Europe and a dark path to the South Pacific target area existed.



STILL GOING STRONG

Thankfully, icing conditions are not a consideration at this equatorial location, which allows for considerably lighter tower and antenna construction requirements.

This antenna array, placed in service in October 1963, is still in use 42 years later. It is located in the Andean Mountains near Quito Ecuador at an elevation of 8,500 feet.

Bob Seaberg is a veteran radio and television engineer with over 60 years experience in the US and South American broadcasting. His email contact is seaberg1@juno.com

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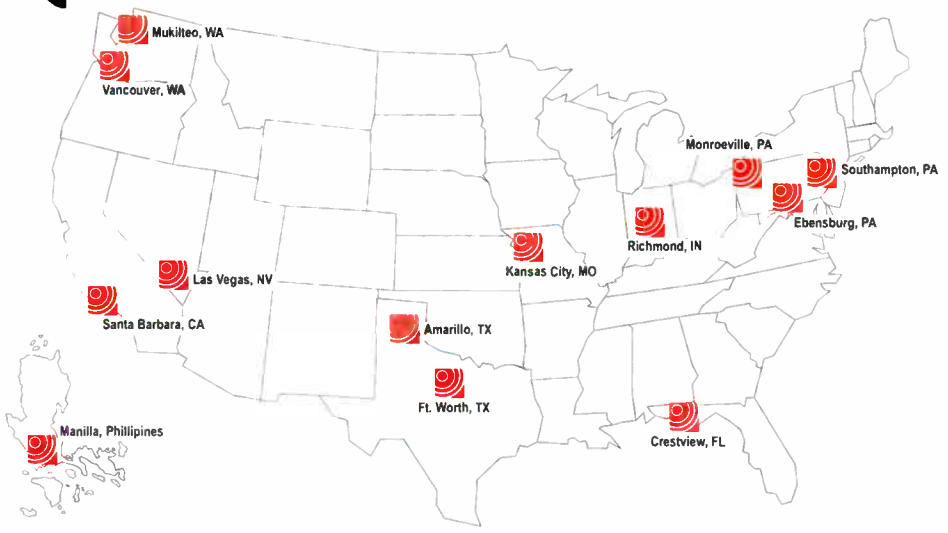

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Studio Guide

by Mark Shander

The Auxiliary Production Room

[PHOENIX, Arizona] Depending upon environment, users, budget and (of course) product-related issues like quality and performance, most of us have our favorite microphone brands and configurations, as well as our favorite microphone/processor combinations.

With so many variables and personal biases affecting the selection process, it is often hard to be objective when selecting microphones for a particular need. To make this more fun, consider the situation many of us run into quite frequently.

THE TASK

You are at a small-to-medium-sized station in a medium-sized market, with a modest budget. Your station needs an additional production room configured to off-load the demands on the primary production studio.

In this scenario, the proposed solution is based on a pre-approved budget. Nevertheless, you are asked to find a way to reduce the equipment costs. (One might legitimately wonder why it is called a "pre-approved budget" if you are always being asked to reduce equipment costs when submitting proposals that fall within budget guidelines.)

The new production room was formerly the jock lounge. Some of the couches and tables in the room are being kept; you are to add only what is needed to record spots in there.

PROD ROOM OR LOUNGE?

Now this scenario really hits home! You are not creating an auxiliary production room, you are adding production capability to the jock lounge – a noise and acoustical disaster. Obviously, management feels this project is not really important – just throw some equipment together and make it work.

One of my first concerns in a scenario such as this used to be soundproofing – how to make the room as quiet and sound-dampened as possible. Nowadays, my first concern relates to the finished product: do the recordings need to be networked? How does the finished product get to other digital solutions in the station? What is the workflow like for this solution, and can I shave some steps off somewhere?

In this scenario, the jock lounge has a few aging P3/600 computers in it used by the jocks for prepping material, Internet access and recreation. For safety, this group of computers is isolated from others on the stations network with a switch.

As noted, management is more concerned with hardware cost than time efficiency. It is very important to know how success is measured at a facility. While business cases showing ROI in terms of workflow efficiency and time savings typically make sense on Wall Street, the fact is that in the trenches, those rules do not always apply. In this scenario, we are stuck using the P3/600s, whether they rob the station of time or not, because a new computer is not in the budget.

REAL WORLD BUDGET

The real budget available turns out to be $1,000. But you remember this is not really an important project, and you are just supposed to throw some equipment together to make it work.

Besides, it is not so bad; this is an auxiliary production studio, and it is going to be used mostly for spot production. With shorter program material to work with, even a slow computer should not tie someone up too long. Some simple acoustic treatment may be sufficient.

After steaming off the gook on the keyboards so you can type on them once again, you decide to leave one of the three computers for prep. Two are all you will need to add some efficiency to a scenario that would normally be very slow and tedious.

Lacking a fast computer, the next best thing is to add a KVM (Keyboard/Video/Mouse) switch to the pair you are going to use for production. This will let you use a single mouse, a single keyboard and a single monitor to control two computers.

One particular manufacturer has a solution that can be acquired for about $40. To switch between one computer and the other, you hit <SCROLL LOCK> twice. Since the computers are networked, they can share directories and you can access the same stored file from either computer.

MICROPHONE SELECTION

Since the microphone you really want to use costs more than $150, you are forced to use something you plan to eventually upgrade. While you are tempted to go to Radio Shack and pick up a Karaoke microphone shaped like a daisy from a children's toy to illustrate your point, a more useful choice might be a Sennheiser e835; it streets as low as $100.

Ideally, a microphone preamp and processor, a nice higher-end sound card and maybe even a digital connection between the pre-amp and the computer would be nice. Realistically, you settle for a balanced-to-unbalanced connection between the microphone and the analog input for the existing sound card. Some sound cards are built into the motherboard, and electrical noise can be high. However, other sound cards (and even motherboard-embedded solutions) are very acceptable.

There is a wide range of cost-effective editing software for PCs; make sure you have a current version of whatever you are using on both computers. Use one for the microphone input, the other for FTP or SSH clients or a CD-RW unit to transfer files. That way, one computer handles transportation and delivery while the other is handling the recording and processing for production.

In the end, for very little money, you have taken two aging computers and integrated them into an efficient, powerful multi-tasking production tool that any good spot producer would have no trouble using to whip out spots (even some award-winners) when the primary facility is not available. Getting fried chicken out of your new production keyboards (or grease off the microphone capsule) is a whole 'nother column.

Mark Shander has been involved in studios from small to large, in radio, TV and the Internet. He can be contacted at mark@shander.com

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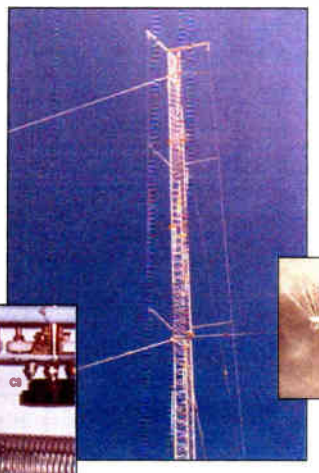

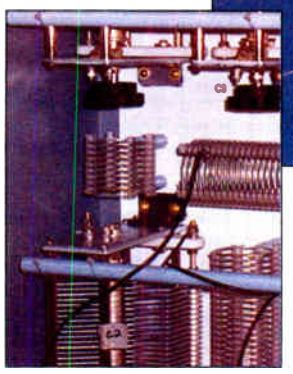

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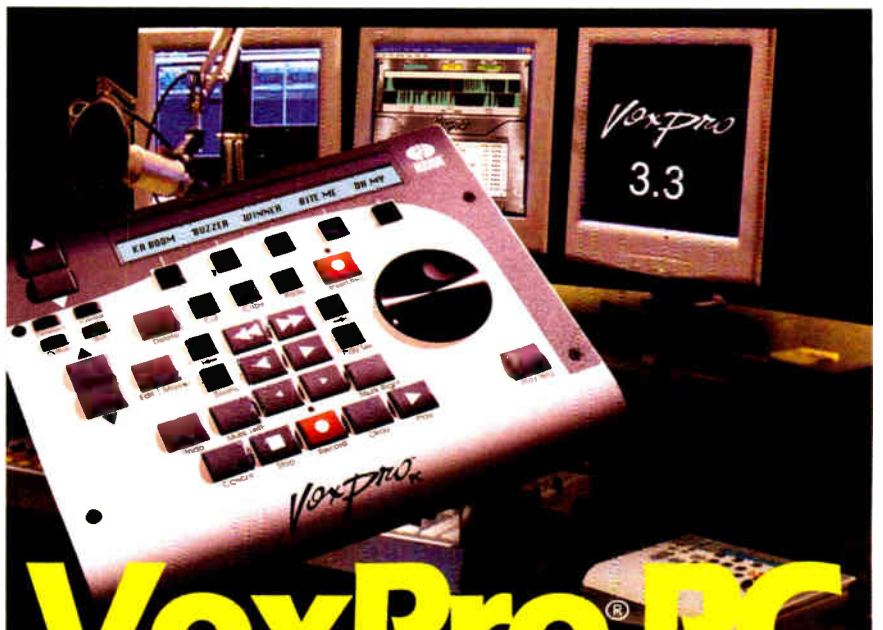

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Tool Guide

From the Radio Guide Tool Box

Cable Testers

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WHIRLWIND – *Tester*

This versatile cable tester checks many varieties of audio cables. It tests most cable combinations of XLR, 1/4" or RCA Phono plugs for shorts, opens, and polarity reverse. The hands-free design allows manipulation of the cable to locate intermittents. An On/Off switch is provided, with an LED to indicate sufficient testing power. Belt clip included.

ART – *CableCOP*

The CableCOP features a full selection of standard pro audio connectors for testing all such cables. LEDs on the CableCOP link its various connector terminals and will only illuminate when the connected 'cable' completes a circuit. As a result, you are able to tell, at a glance, which cables need to be repaired.

An LED may also fail to illuminate if a 3-conductor cable has been wired out-of-phase. As an example: if the Tip of one 1/4" TRS plug on a (balanced) patch cable were soldered to the same cable conductor as the Ring or Sleeve of the other 1/4" inch TRS plug.

BEHRINGER – *CT100*

This durable tester accepts XLR, mono and TRS phone (1/4", 1/8", TT), RCA and MIDI. The LED display shows which input pin is connected to which output pin. Separate shield and phantom power LEDs indicate proper shield connection and phantom power presence. The CT100 requires insertion of only one plug and indicates shorts and opens, as well a continuity check. A test tone generator (1 kHz and 440 Hz) is also included. Priced low enough to have several at the studio.

EBTECH – *Swizzarmy*

With a comprehensive connection set that includes XLR, 1/4, RCA, 1/8, TT and MIDI connectors, the Swizz Army can be used to tell the exact wiring of any cable or adaptor. The device clearly shows continuity, opens and shorts, even intermittent shorts! It also features test tone generation, phantom power detect and grounded XLR shield detect. Runs on two AA batteries.

HOSA – *CBT277*

The CBT-277 cable tester by Hosa is a high-quality junction box with connections for Neutrik Speakon, XLR, 1/4-inch phone, RCA, and dual banana, along with a comprehensive set of buttons and LED indicators that not only tell you if a cable is wired incorrectly, but will actually differentiate between shorts, ground faults and phase mis-wirings. This is truly an indispensable tool for the audio professional.

TEST-UM – *TP300*

The TP300 Resi-Tester by Test-Um is the first identifier and verification tester designed exclusively for all the wiring environments found in Home Networking and Home Automation. CATV, telephone systems, audio cable, security/alarm wiring, and network cabling can all be tested and located using the Resi-Tester and optional room identifier sets. Multiple input ports and included adapter cables mean any wire can be attached and tested!

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Survival Guide

By Rich Wood

Henny Penny
(Adjusted for Inflation)

We can hear the voices saying "It's too late! Satellite radio (or WiFi or podcasts or cellcasts) is going to kill off terrestrial radio!" Rich Wood is here to remind us there is life yet in Broadcasting.

[EASTHAMPTON, Massachusetts] The air is heavy. While Los Angeles is used to it because of the weight of the air, the rest of the nation is suffering from unusual falling skies.

Maybe not the entire population, but it seems to be infecting the radio industry and those in close contact. "Radio is dead." The prediction comes from the highest realms of current and former broadcasters at industry gatherings where very bad food is served.

WOE IS US!

Even worse, groupies give us mere weeks to survive before some awesome new technology wipes traditional broadcasting from the face of the earth. All this makes me feel like a kid again with my collection of *Mechanics Illustrated*, convinced we would colonize the universe by the time I reached 18, a mere few years ago.

Now, just moments in cosmic time since the satellite services launched their spaceballs to wipe us out, we hear they will be obsolete, and IBOC will suffer the fate of a snowball in the Netherworld.

We are being psychologically suckered by people with competing agendas. The paranoid among us believe the government wants our spectrum. Computer geeks see the world cobbled together with 300-foot WiFi signals delivering awesome quantities of audio and video data on top of gaming that requires top-of-the-line Cray computer-like capacity. Telcos salivate over bringing us that same data at per-minute rates.

LUDDITES R US

At the risk of being labeled a Luddite (inaccurate because I use all these technologies) I believe traditional radio has a long and prosperous life ahead, with or without IBOC/IBAC/DRM (... fill in any missing scheme). Wall Street seems to agree; a recent business magazine report predicted radio will continue to throw off huge amounts of cash for some time to come.

I see solutions in search of problems – solutions not ready for prime time but rushed to market. I recently moved 14 miles only to find myself in a pocket of inoperative whizbang technology. I had to change my cellular provider because of a five-mile null. My new cable system is lucky to deliver local analog, let alone HDTV. Off-air HDTV requires yoga dexterity to position the antenna.

So far, the only absolutely reliable technology is good old-fashioned radio.

HYPE-ER INFLATION

We create hype as a product; showbiz is, by nature, an exaggeration of life. Very few of us suffer the way soap opera characters do, yet we find ourselves glued to the inflated drama that makes it more interesting than the lives we live. Or, it allows us to sigh in relief that someone else has it worse.

However, that hyped drama loses not only its creative credibility but its entertainment value when the hype overwhelms any vestige of reality.

The core of radio is healthy. Yes, fractionalization caused by new technologies is nipping at our heels. However, the huge lead broadcasting has provides time to map out realistic strategies to remain an important service for that vast majority of the world's population with more compelling things to do than focus on constantly changing predictions of impending doom.

Early adopters are convinced the new technologies they embrace will sweep the nation once word gets out. In most cases the population responds with a collective yawn and goes back to what they find familiar.

In recent decades only a couple of technologies have actually revolutionized their industries. CDs and DVDs, in cosmic time, caused quick and dramatic changes in how we entertain ourselves. CD and DVD players are almost as common as TV sets in most homes – but not as common as radios. Those are everywhere in every imaginable configuration, and their portability lets them work virtually anywhere they find a signal.

HYPER EFFICIENT

I doubt anyone can argue that broadcasting is not one of the most efficient ways of disseminating information and entertainment. Adding listeners puts no additional load on the transmitter. Only the power company works harder as a station's ratings increase. Each of the non-broadcast technologies adds loads and additional costs to the provider.

The latest prediction is cell phones will be the Swiss Army Knives of communication and entertainment. A nation suffering from carpal thumb syndrome, headaches and eyestrain is sure to follow.

Even more serious will be the lack of batteries powerful enough to let us get through more than a couple of hours before we need a couple of hours to recharge. History has shown that devices intended to be all things to all people generally fail because of the compromises that have to be made.

The bottom line is technology is not a zero sum game. Neither is entertainment. To butcher Mark Twain: the reports of radio's death are greatly exaggerated. We have our weaknesses, based mostly on Wall Street demands for profit at any price. However, our strengths far outweigh them. We need to fight the doomsayers and prevail.

With over four decades of experience ranging from local stations to network operations, Rich Wood watches the industry from Rich Wood Multimedia headquarters in Western MA. Contact Rich at: richwood@pobox.com

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Consultant Guide

Radio Consulting Engineers

Missing Your Radio Guide?
Get Them All on the BDR

Version 2.0 of the Broadcaster's Desktop Reference now includes every issue of Radio Guide since January 2003 to the present. Plus, there is an index for the PDFs, for easier location of older articles.

The BDR (Broadcaster's Desktop Reference) is an ongoing effort to provide useful tools, information, and history of interest to broadcasters.

The CD includes several sets of Radio Utilities, an AM and FM/TV database viewer (including DA patterns), as well as EAS printer paper sources, project schematics, historical data and pictures – even some humorous Top Ten lists.

Recent additions include updated FCC and EAS checklists, and some equipment manuals. Having this out at the transmitter site can save you lots of time and effort.

A Table of Contents for the BDR can be found at: www.oldradio.com/bdr.htm

The proceeds from this CD fund both future improvements of the BDR as well as helping the efforts of oldradio.com to document the industry's history.

There is no set price for the BDR. Many find $15-$20 appropriate to cover the costs of materials and shipping, plus a little extra for funding the improvements. If you pay more, it will be put to good use.

If you have wideband Internet, we can now make arrangements for you to get the BDR quicker, via the Internet.

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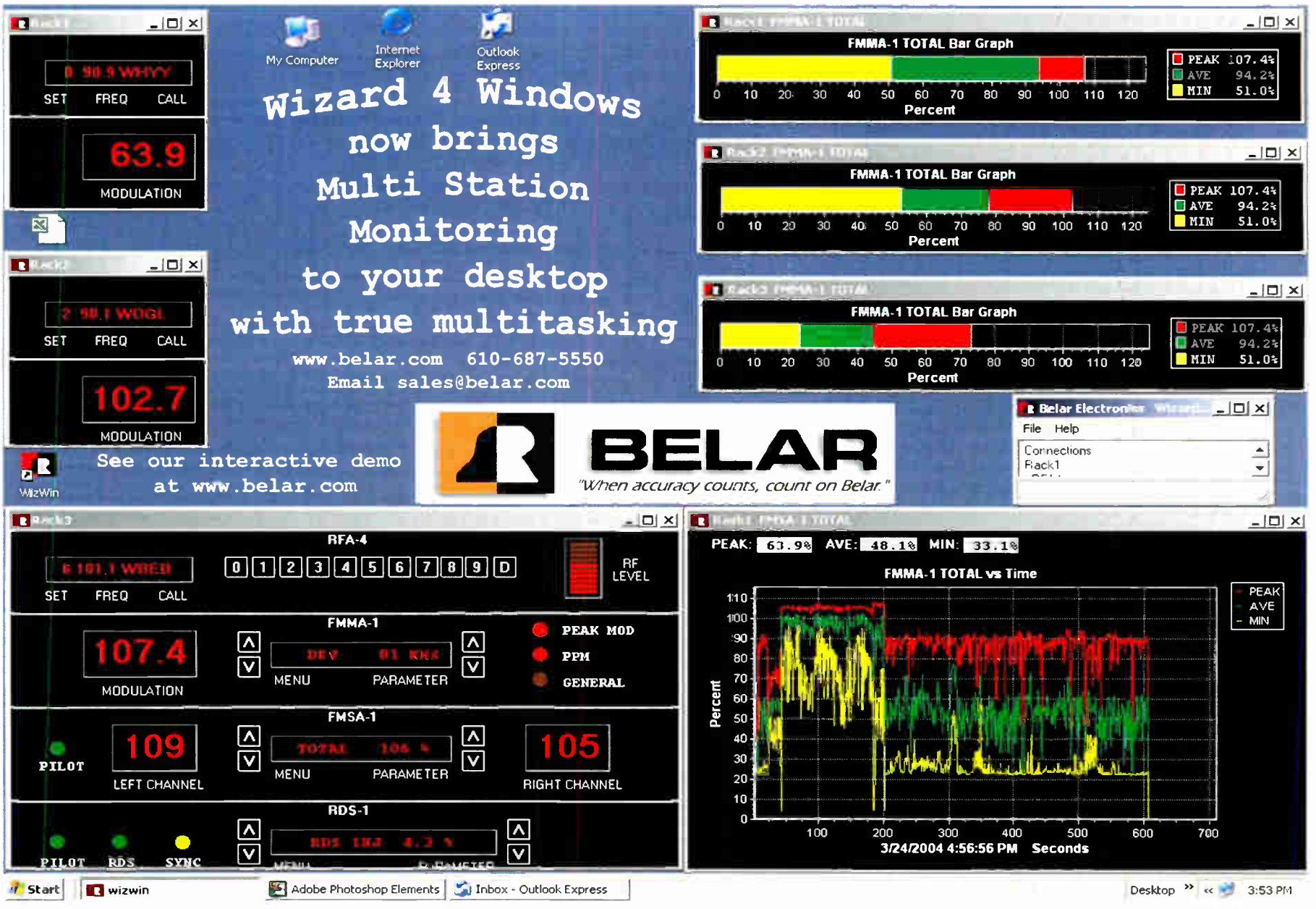


Gear Guide: STL, TSL, RPU, Wireless Remote Control, Monitors

Armstrong

XLink – STL System

www.armstrongtx.com • 315-573-1269

XLink is Armstrong's newest generation of field proven STL systems. This microprocessor-controlled system is frequency agile with improved sensitivity and better selectivity.

The front panel LCD display provides easy control and monitoring of system parameters plus the XLink is remote control ready.

XLink is a perfect platform for your digital conversion as it quickly interfaces with Armstrong's DX Series of Digital encoders and decoders. The Xlink has connections for Mono or MPX and up to three SCA inputs.

XLink is backed by Armstrong's one year part and labor warranty, our 24/7 technical support and our emergency loaner program.

Belar

FMHD-1 – Precision Digital FM HD Monitor

www.belar.com • 610-687-5550

The Belar FMHD-1 is a state of the art HD radio monitor based on the latest decoder from Ibiquity The monitor decodes both HD and analog signals simultaneously, displaying HD radio status, data, time alignment, and configuration information, as well as audio metering and RF/audio spectrums.

The FMHD-1 currently supports monitoring multiple audio streams and simultaneous monitoring of two streams with an optional second plug-in HD decoder.

The units have 8 user assignable analog audio outputs, and 3 assignable optical AES/EBU outputs to provide support for a wide variety of broadcast scenarios, including Tomorrow Radio and 5.1 Surround Sound.

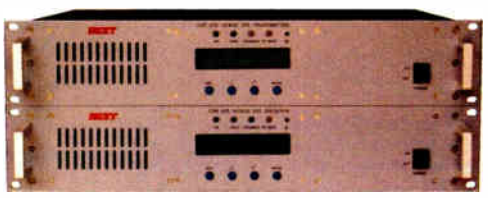
In addition to an antenna input for monitoring off the air, the FMHD-1 has two high level RF inputs for transmitter site operation. The dual RF inputs allow for monitoring at installations using two transmitters to generate the combined Analog/HD signal. The FMHD-1 is compatible with the Belar Wizard Software.

BEXT

LDT/LDR – Composite STL Series

www.bext.com • 888-239-8462

The 940 - 960 MHz Composite LD STL Series from Bext has been recently updated with the arrival of a new high performance receiver that offers improved sensitivity and selectivity.



Both the LDT STL Transmitter and the LDR STL are microprocessor supervised and are directly digitally programmable on any frequency within the standard STL band from the front panel via a user friendly menu-based LCD display.

Both units have auto sensing, extended range power supplies, capable of operating on any voltage from 90V to 260V AC.

A 24 VDC input is also provided for direct DC operation.

The optional CDXE and CDXD encoder and decoder modules allow for completely digital audio. Standard output power of the LDT STL Transmitter is 10 W. Optional amplifiers can boost up the power up to 20 and 40 W.

Broadcast Devices

CDS-302 – Composite Audio DA/Switcher

www.broadcast-devices.com • 914-737-5032

The CDS-302 Composite Audio DA/Switcher is designed to accept two FM baseband signals from a suitable STL system which can be switched and distributed to two analog FM exciter wide band inputs. Outputs have individual level controls for matching to different exciter inputs. The CDS-302 has a built in silence sensor, negating the need for an external one.

The unit is also equipped with an RBDS loop-through feature for adding RBDS to baseband signals, which can be fed to two exciters with just one RBDS encoder. Add the optional CTD-1 Composite to AES Generator module and you can convert any analog composite STL or stereo generator output to a pair of AES3 outputs suitable for analog or digital broadcasting. The CTD-1 has selectable pre emphasis defeat and can generate 32, 44.1, 48, or 96 kHz sample rates.

Broadcast Electronics

SRPT-40/SR-40A – Marti Remote Pickup Units

www.bdcast.com • 217-224-9600

After more than 40 years of taking care of your remotes, Marti remote pickup units (RPUs) are better than ever. Inside of every Marti product is a mix of old and new: the reliability, friendly-operation and ruggedness you demand, along with the quality that only comes from the latest technologies. Consider the SRPT-40A RPU transmitter and its companion SR-40A RPU receiver.

These units are fully synthesized and frequency-agile. The SRPT-40A transmitter includes a mixer with three mic and one mic/line inputs. Marti also offers dual-frequency transmitters and receivers in several configurations, including the RPT-2B hand-carried, portable 2.5 watt transmitter with rechargeable battery; it practically defines "grab and go!"

Marti can help you put together your complete remote rig with antennas and accessories.

Broadcast Tools

WRC-4 – Web-Based Remote Control

www.broadcasttools.com • 360-854-9559

The WRC-4 is a fresh approach to remote site monitoring and control, or providing an inexpensive solution to Internet-enabling your present remote control system. The WRC-4, combined with web access and your favorite web browser, brings you the following features all available in this small, but powerful tiny TOOL: A powerful built-in web-server; 10/100baseT Ethernet port; four each channels of 10-bit analog inputs; optically isolated status (contact closures) inputs; SPST relays; open collector outputs; front panel status indicators and a single front panel temperature sensor.

The WRC-4 is supplied with plug-in Euroblock terminals and loaded with a generic web page that may be edited by the end user. Multiple WRC-4's may be used with a user provided Ethernet hub. The WRC-4 may be set on a desktop, mounted on a wall or up to four units mounted on the 1-RU, RA-1 shelf.

Gear Guide: STL, TSL, RPU, Wireless Remote Control, Monitors

Gorman-Redlich

CMR – DA Digital Antenna Monitor

www.gorman-redlich.com • 740-593-3150

The Model CMR is a state of the art instrument of unequalled accuracy and stability, at a price comparable with analog monitors. With typical modulation, the CMR's true ratio readout is a factor of 10 more stable than instruments that measure normalized amplitude, and its phase readout is accurate, rock solid, with automatic phase sign. Practically, these features mean quick, accurate log or remote readings. The CMR is fully remoteable, using standard remote control equipment.

The CMR's outstanding performance and reasonable price make it ideal for new DA installations or for modernizing the instrumentation of existing stations.

True Ratio reading: Non-Reference and Reference amplitudes are separately measured and divided electronically to give an accurate digital reading that will not vary with carrier level, and is exceptionally stable under conditions of deep, unsymmetrical modulation.

Inovonics

531 – FM Modulation Monitor

www.inovon.com • 831-458-0552

The Inovonics 531 FM Mod-Monitor combines a synthesized, dual-conversion receiver with precise bargraph metering. This offers the broadcaster an accurate means of measuring signal parameters, either at the transmitter site or from the studio. In addition to a high-resolution Total-Mod reading, other useful displays include demodulated left and right audio, plus stereo pilot and RDS/SCA subcarrier injection levels. The input RF level and multipath distortion are also shown to aid in receive antenna alignment.

The 531 monitors incidental AM noise in the FM carrier as well, and permits headphone monitoring of this and the normal audio outputs. Balanced stereo audio is provided, as well as program-loss and carrier-loss alarms that may be monitored remotely. Although the 531 does not specifically address HD Radio, the presence of IBOC carriers affects the Total-Mod reading by 3% or less. See full details at www.inovon.com.

Moseley

SL9003T1 – Starlink STL/TSL

www.moseleysb.com • 805-968-9621

Moseley Starlink SL9003T1 is a fully featured digital STL/TSL system for T1 circuits or license-free 5.8 GHz links.

The Starlink T1 system allows stations to easily transition their air chains to digital for HD Radio™. Starlink transports linear uncompressed stereo program audio at 44.1 or 32 kHz sample rates. Both AES/EBU digital and analog inputs and outputs are included. Each audio module includes a built-in serial data channel for RDS or transmitter remote control.

Optional Ethernet connectivity extends the station LAN to the transmitter site to support remote servers, browser-based equipment control and HD Radio. Audio channels can be added for backhaul of RPU and off air monitor as well as voice channels for telephone extensions at the transmitter site.

OMB

MT/MR Platinum – Studio Transmitter Link

www.omb.com • 305-477-0973

OMB has recently introduced to the market its new model MT/MR Platinum STL system. The transmitter has a power output of 20 W (twice the RF power than the earlier models), it is microprocessor-controlled and has an LCD display for parameter selection and readings; it is externally synthesized, and very easy to work with. The receiver, with same easy to use features, offers double-conversion for very clean reception. It is designed for frequency bands from 200 MHz to 400 MHz and 900 MHz in band blocks of 20 MHz.

OMB provides a delivery lead time of about three days, and a continuous stock of spare parts and technical support. OMB STL systems offer quality signal transmission, and reliability They are well designed throughout, and are offered at a reasonable price.

Sine Systems

RFC-1/B – Remote Control System

www.sinesystems.com • 615-228-3500

The RFC-1/B is an affordable, full-featured transmitter remote control system that can be accessed through a standard telephone or cellular phone. Readings are reported with a natural sounding human voice. A basic system consists of an RFC-1/B and an RP-8 Relay Panel that provides eight channels of telemetry and raise/lower control. Up to eight relay panels can be connected for a maximum of 64 channels. The RFC-1/B can be programmed to perform power/pattern changes and take readings automatically.

It can also be programmed to alert station personnel during an alarm condition. Several accessories are available: For surge protection on the telephone line and telemetry signals use the SP-8 Surge Protector. Model RAK-1 provides battery backup, printer port and data modem. Use model ACM-2 for tower lights.

TFT

5290/5291 – Analog STL System

www.tftinc.com • 408-943-9323

TFT introduced a new front panel frequency-agile analog STL system at this year's NAB. The new system features a 10-Watt transmitter and receiver with improved sensitivity. Both are truly frequency adjustable in 6.25 kHz steps from the front panel without any need for tuning or further optimization.

The 5290 transmitter and 5291 receiver can be field-adjusted for composite or monaural operation. A front panel LCD displays operational information regarding frequency, power, received signal level, VCO voltages, etc.

The transmitter can be used with any TFT standard STL accessories and is also available in a 20-Watt version. The receiver has two selectable IF bandwidths and has high/low RF pre-amp gain. Applications include clustered stations with need for a spare for any frequency and stations with smaller budgets that need only a basic STL package. Transmitter and receiver list for $4,695.00.

Service Guide: Radio Equipment Products and Services

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Belar - 41	www.belar.com
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Broadcast Devices - 35	www.broadcast-devices.com
Broadcast Electronics - 38	www.bdcast.com
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Listen to IP-Audio with Axia iPlay

Axia Audio announces Axia iPlay, a software-based IP-Audio monitoring program that lets Windows® PC users select and listen to any audio source available to their Axia network with the click of a button.

Axia IP-Audio networks convert analog and digital audio sources into uncompressed, real-time PCM audio and distribute it throughout the broadcast plant via switched Ethernet.

iPlay allows users of desktop and laptop computers that are connected to an Axia network to easily choose and play any available stream, without the need for external audio inputs or adapter boxes.

216-241-7225 • www.AxiaAudio.com

2005 Radio Guide Event Calendar

Email your information to: radio@rconnect.net

SBE Certification Exam
Jun 3-13 – Local Chapters – Apr 22 App Deadline

Northern New England Broadcasters & SBE-110
June 23 – Manchester, NH – bteffner@wcax.com

Texas Assoc. of Broadcasters (TAB)
Aug 3-5 – Austin, TX – www.tab.org

Nebraska Broadcasters Assoc. & SBE-74
August 10-12 – Lincoln, NE – www.ne-ba.org

SBE Certification Exam
Aug 12-22 – Local Chapters – Jun 10 App Deadline

IBC2005 Conference
September 8-12 – Amsterdam – www.ibc.org

2005 Fall Radio Show
September 21-23 – Philadelphia – www.nab.org

SBE Chapter 22
September 28 – Verona, NY – www.www.sbe22.org

Pittsburg Chapter 20 Regional SBE
Early Oct. – Pittsburgh – www.broadcast.net/~sbe20

Audio Engineering Society (AES)
Oct 7-10 – New York, NY – www.aes.org

Madison Broadcasters Clinic
Oct 11-13 – Madison, WI – www.wi-broadcasters.org

Boscon, Boston & SBE 11
Oct 25-26 – Marlborough, MA – www.bos-con.org

Arizona Broadcasters & SBE 9
Mid October – Phoenix, AZ – www.sbe9.org

SBE National and 2nd Annual Engineering Expo
Oct 10-20 – Grapvine, TX – sandytex@swbell.net

SBE Chapter 16 Regional Convention
October – Seattle – www.broadcast.net/~sbe16

CAB-2005 Canadian Assoc. of Broadcasters
November 6-8 – Winnipeg – www.cab-acr.ca

SBE Certification Exam
Nov 11-21 – Local Chapters – Sep 23 App Deadline

AES to Expand Broadcast Events for 119th Convention

In response to growing interest in radio and TV broadcast audio issues, David Bialik, Broadcasting Events Chair for the 119th AES Convention is inviting topic suggestions from the broadcast community. The 119th Audio Engineering Society Convention will be held in NYC's Javits Center Oct. 7 - 10, 2005.

"Broadcasting is in a period of transition," Bialik said. "Previous AES Convention Broadcast events have covered subjects ranging from Surround Sound and satellite technology to employment opportunities in the new Digital environment. We already have a number of strong suggestions for special events, workshops, papers and roundtable discussions for the 119th Convention. However, in the interest of providing as comprehensive an agenda as possible, we are opening the floor to new ideas.

Industry professionals with broadcast-related audio subjects they would like to see addressed at the AES Convention this fall are invited to send brief proposals to: 119th_broadcastevents@aes.org.

SBE Introduces AM Directional Specialist Certification

The Society of Broadcast Engineers (SBE) has introduced the AM Directional Specialist Certification, the first of a series of Specialist Certifications the organization plans to establish.

The SBE Certification Committee has developed an exam that will help evaluate an individual's ability to perform the necessary tasks to keep AM directional facilities operating properly.

The SBE exam will cover the operation, maintenance and repair of a directional antenna system, the tasks common to a station engineer charged with maintaining these systems. The exam will also gauge a person's knowledge of AM radiators, their understanding of the principles of phase addition and cancellation, familiarity with the various components used in a directional antenna system and their ability to correctly make necessary measurements and take proper procedures to make repairs and adjustments to the system. In addition, the exam will cover the FCC rules concerning directional operation, test equipment and safety procedures. The AM Directional Specialist Certification exam will consist of 50 multiple-choice questions.

To obtain an application for the SBE AM Directional Specialist Certification, visit the SBE website at www.sbe.org and click on the link to the SBE Certification Program.

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